FARMINGTON RIVER BASIN
TOLLAND, MASSACHUSETTS

LOST WILDERNESS LAKE
NORTHERN DAM
MA 01059

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

DECEMBER 1979

UNCLASSIFIED

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19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

DAMS, INSPECTION, DAM SAFETY,

Farmington River Basin
Tolland, Massachusetts
Tributary of West Branch Farmington River

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The dam is an earthen embankment 240 ft. long and 23 ft. high with a drop inlet principal spillway structure and a 10 inch outlet conduit. The dam is intermediate in size with a low hazard classification. Failure of the dam will not threaten any homes, The only significant damage attributable to a dam failure is the culvert crossing East Otis Road, which is a secondary gravel surfaced roadway.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:

NEDED

DEC 9 1980

Honorable Edward J. King
Governor of the Commonwealth of
Massachusetts
State House
Boston, Massachusetts 02133

Dear Governor King:

Inclosed is a copy of the Lost Wilderness Lake Northern Dam (MA-01059) Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Quality Engineering, the cooperating agency for the Commonwealth of Massachusetts.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Quality Engineering for your cooperation in carrying out this program.

Sincerely,

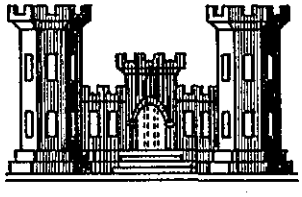
WILLIAM E. HODGSON, JR.
Colonel, Corps of Engineers
Acting Division Engineer

Incl
As stated

FARMINGTON RIVER BASIN
TOLLAND, MASSACHUSETTS

LOST WILDERNESS LAKE
NORTHERN DAM
MA 01059

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

DECEMBER 1979

LOST WILDERNESS LAKE DAMS
NORTHERN DAM
MA 01059

WEST BRANCH OF THE FARMINGTON RIVER BASIN

TOLLAND, MASSACHUSETTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Indentification No.:	MA 01059
Mass. D.P.W. No.	1-7-297-3
Name of Dam:	Lost Wilderness Lake - Northern Dam
Town:	Tolland
County and State:	Hampden County, Massachusetts
Stream:	Tributary of West Branch Farmington River
Date of Inspection:	October 31, 1979

BRIEF ASSESSMENT

The Northern Dam is located at the northwest corner of Lost Wilderness Lake (formerly Twining Pond) which is approximately 2.5 miles west of Tolland Center in Tolland, Massachusetts. A second dam, Twining Pond Dam (MA 00321) was also constructed to form Lost Wilderness Lake. The dam was constructed as part of a recreational community and land development project. The dam is an earthen embankment 240 feet long and 23 feet high with a drop inlet principal spillway structure and a 10-inch outlet conduit. The emergency spillway is located at the right abutment of the dam and the spillway is 30 feet wide at the control section. There is also an earthen dike which is approximately 400 feet long and 8 feet high to the right of the emergency spillway.

The dam is owned by Lost Wilderness, Inc. which is currently being managed by the Woronoco Savings Bank of Westfield, Massachusetts.

The drainage area affecting the Lost Wilderness Lake Dams is approximately 1.22 square miles and is comprised of heavily wooded rolling terrain. The dam impounds approximately 1,200 acre feet at the normal pool elevation of 1,349 feet MSL and 2,000 acre feet at the top of the dam elevation of 1,355.5 feet MSL. The Northern and Twining Pond dams are INTERMEDIATE in size. The Northern dam is a LOW hazard classification and Twining Pond dam is a SIGNIFICANT hazard classification.

The test flood for this dam is one-half the Probable Maximum Flood (½ PMF). For this drainage area the ½ PMF is 1,390 cfs. When this flood is routed through the reservoir, the resulting outflow is 960 cfs. The spillways of both the Twining Pond Dam and the Northern Dam would be used to relieve the test flood since both spillways are indicated to be at the same elevation. The combined emergency spillway capacity is 5,140 cfs. The elevation of the spillways was determined from construction drawings; no field levels were made to check elevations. The spillway test flood outflow would be about 160 cfs from the Northern Dam and 800 cfs from the Twining Pond dam. The depth in the spillways would be approximately 1.3 feet with a freeboard of 3.2 feet remaining to the top of the dam.

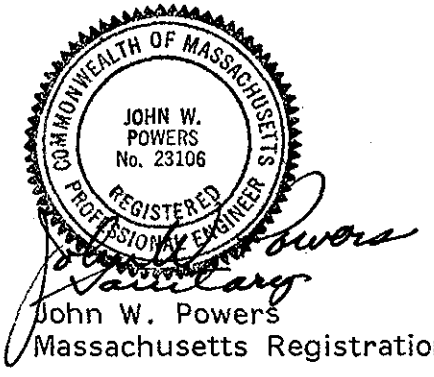
Failure of the Northern dam will not threaten any homes. The only significant damage attributable to a dam failure is the culvert crossing East Otis Road, which is a secondary gravel surfaced roadway.

The dam is generally in good condition, however, the emergency spillway is only in fair condition due to rock outcrops in the emergency spillway channel. The dam is, therefore, assessed to be in FAIR condition.

The rock outcrops in the emergency spillway channel should be removed to provide the design cross-section through the spillway. The source of the wet condition along the downstream toe of the dike should be investigated and remedial action taken if necessary.

Remedial measures to be undertaken by the Owner include: implementing a program of periodic maintenance; backfilling tire ruts, erosion, and low spots in the embankment and the dike; mowing embankment slopes and removing debris from the emergency spillway entrance.

The recommendations and the remedial measures contained herein should be implemented within one year of receipt of this report by the Owner.



John W. Powers
Massachusetts Registration 23106

This Phase I Inspection Report on Lost Wilderness Lake/Norther Dam (MA-01059) has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Richard J. DiBuono

RICHARD DIBUONO, MEMBER
Water Control Branch
Engineering Division

ARAMAST MAHTESIAN, CHAIRMAN
Geotechnical Engineering Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation: however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspecton, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The Phase I Investigation does <u>not</u> include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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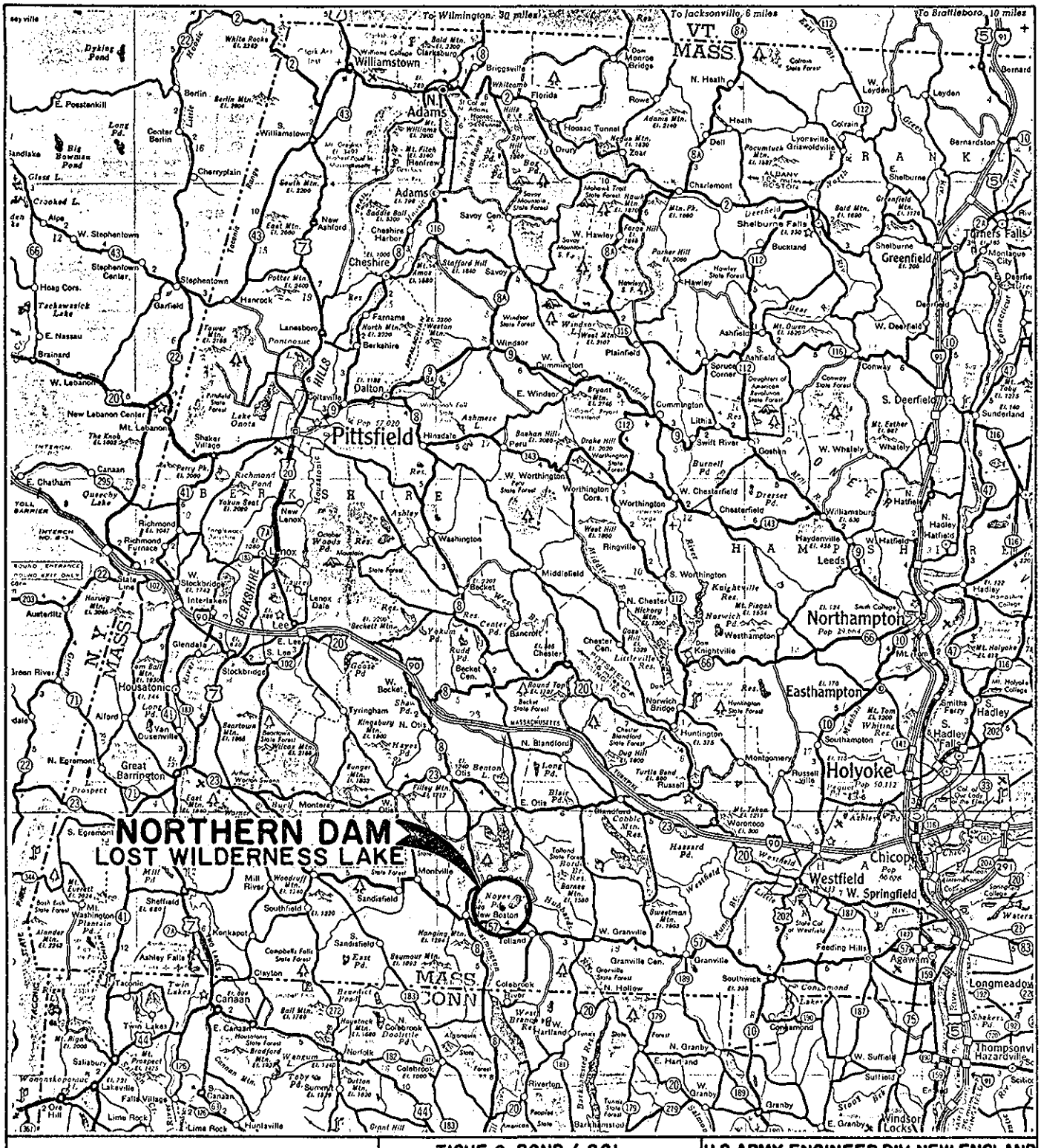

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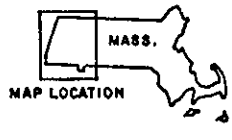


MAP LOCATION

TIGHE & BOND / SCI
CONSULTING ENGINEERS
EASTHAMPTON, MASS.

U.S.ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

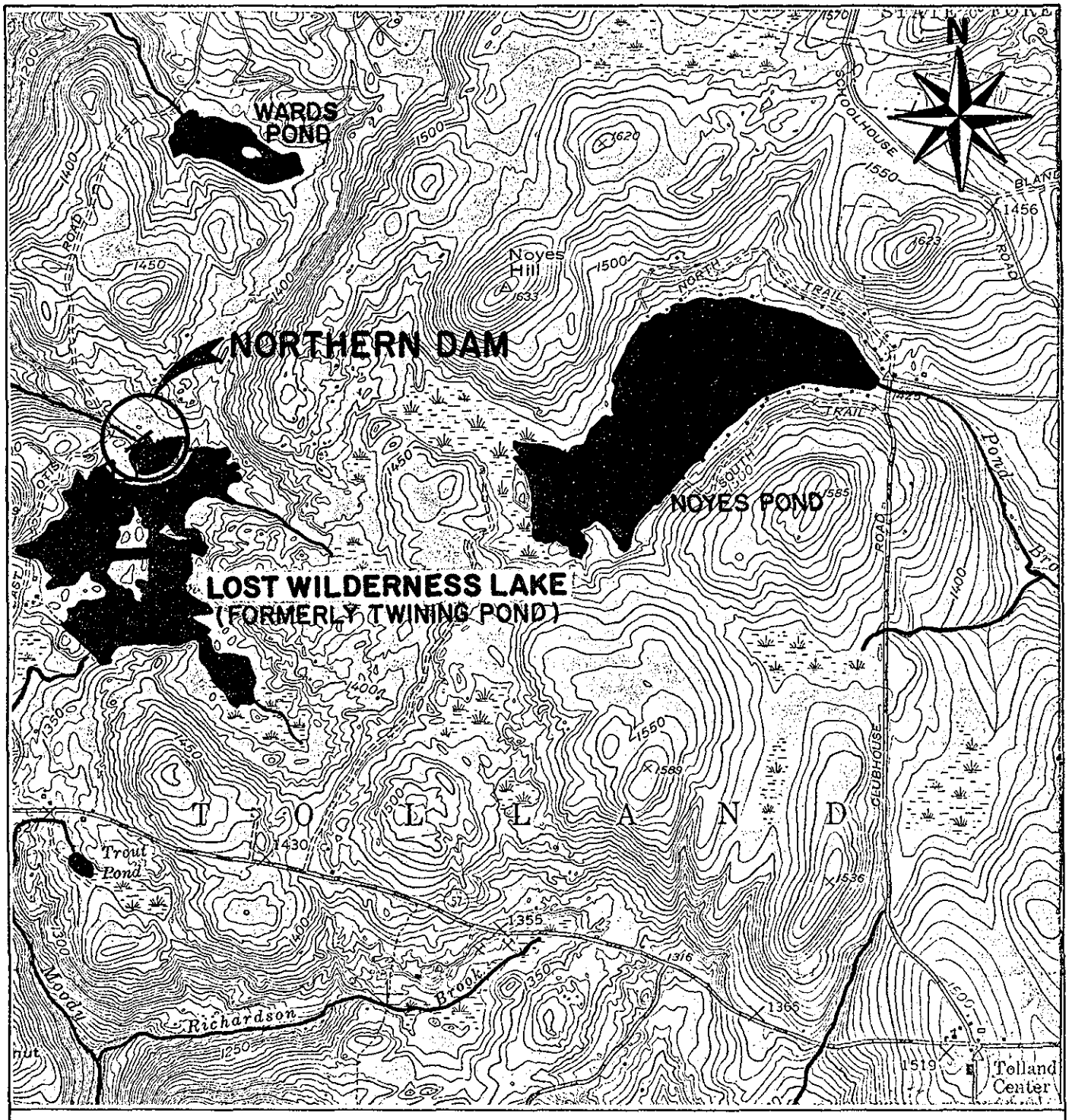
LOCUS PLAN I

NORTHERN DAM (MA01059)
LOST WILDERNESS LAKE
HAMPDEN COUNTY

TOLLAND
MASSACHUSETTS

SCALE: AS NOTED

DATE: DECEMBER 1979



- SCALE -

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FROM: U.S.G.S. TOLLAND CENTER, MASS.-CONN. QUADRANGLE MAP

QUADRANGLE LOCATION

TIGHE & BOND / SCI CONSULTING ENGINEERS EASTHAMPTON, MASS.	U.S.ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCUS PLAN 2

NORTHERN DAM (MA 01059)
LOST WILDERNESS LAKE
HAMPDEN COUNTY

TOLLAND
MASSACHUSETTS

			SCALE : AS NOTED
			DATE : DECEMBER 1979

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

LOST WILDERNESS LAKE - NORTHERN DAM

NO. MA 01059

SECTION 1

PROJECT INFORMATION

1.1 General

(a) Authority

Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Tighe & Bond/SCI has been retained by the New England Division to inspect and report on selected dams in Massachusetts. Authorization and notice to proceed were issued to Tighe & Bond/SCI under a letter of October 24, 1979 from Colonel William E. Hodgson, Jr., Corps of Engineers. Contract No. DACW-33-80-C-0005 has been assigned by the Corps of Engineers for this work.

(b) Purpose

1) Perform technical inspection and evaluation of non-federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-federal interests.

2) Encourage and prepare the states to initiate quickly effective dam safety programs for non-federal dams.

3) Update, verify, and complete the National Inventory of Dams.

(c) Scope

The program provides for the inspection of non-federal dams in the high hazard potential category based upon location of the dams and those dams in the significant hazard potential category believed to represent an immediate danger based on condition of the dams.

1.2 Description of Project

(a) Location

The Northern Dam is located at the northwest corner of Lost Wilderness Lake (formerly Twining Pond) which is approximately 2.5 miles west of Tolland Center in Tolland, Massachusetts. It can be reached from East Otis Road which intersects State Route 57 approximately 1 mile east of the center of New Boston. The dam is not shown on the 1958 USGS Tolland Center Quadrangle which covers portions of both Massachusetts and Connecticut. The dam is located at approximately N-42°-06'-15 latitude and W-73°-03'-15" longitude (see Locus Plans 1 and 2). Page B-1 of Appendix B is a site plan for this dam. The Northern Dam is one of two dams impounding water which creates Lost Wilderness Lake; the other dam is Twining Pond Dam (MA 00321).

(b) Description of Dam and Appurtenances

The dam consists of an earth embankment, a principal spillway with a reinforced concrete riser and an asbestos cement outlet pipe and an emergency spillway located at the right abutment of the dam. The length of the embankment is 240 feet. The separate emergency spillway is 30 feet wide at the control section.

1) Embankment (See pages B-1 & B-2)

The embankment is made up primarily of silty fine sand (Designation SM or GM using the Unified Soil Classification System). It is 240 feet long and is a maximum of 23 feet high. The upstream slope is 3 horizontal to 1 vertical; the downstream slope is 3 horizontal to 1 vertical; and the width of the crest is 15 feet.

Beneath the embankment is an earthfill cutoff trench of approximately 12 feet in width at the bottom. According to available plans, it is constructed of the same silty fine sand material as the embankment. The cutoff trench was designed and constructed to extend through sand and gravel layers to firm bedrock or glacial till.

Riprap approximately 30 feet wide over the upper portion of the entire length of the upstream slope provides erosion protection. The riprap is machine placed, 1' to 2' diameter stone.

2) Principal Spillway (See pages B-1 & B-2)

The principal spillway consists of a reinforced concrete drop inlet structure with an uncontrolled orifice inlet and an outlet pipe which is supported on a concrete cradle.

The riser structure is 5.2 feet high, 4.6 feet wide, and 4.6 feet long The top slab, bottom slab and walls of the structure are 8 inches thick.

The "low stage inlet" is an uncontrolled opening. It is three feet wide and 12 inches high and is located in the upstream face of the riser structure. The water flows over this orifice and drops into the riser structure. It is protected by a trash rack assembly which protects the entire face of the orifice. This assembly is fabricated from galvanized steel reinforcing bars cast into the upstream wall.

The riser structure is drained by a 10-inch diameter Class 150 Asbestos Cement pressure pipe. It is approximately 122 feet long and drops approximately 12.2 feet over that length. The pipe penetrates the downstream side of the riser structure and is supported by the embankment. Plans indicate 3 concrete anti-seep collars cast around the pipe within the embankment.

The downstream end of the conduit extends approximately 35 feet downstream of the embankment to a concrete headwall. The discharge conduit outlets into a small plunge pool.

3) Emergency Spillway (See pages B-1 & B-2)

The emergency spillway was excavated in the right abutment. It curves to the left around the embankment and is 30 feet wide at the control section. The spillway is approximately 320 feet long and its control section is approximately 4.5 feet below the crest of the dam. The side slopes are 3 horizontal to 1 vertical.

4) Foundation and Embankment Drainage

A four foot wide trench drain of clean sand and gravel extends almost the full length of the downstream embankment. The drain includes one 4-inch perforated asbestos cement pipe. It extends 75 feet along the base of the dam and outlets at the headwall.

(c) Size Classification

The maximum impoundment for both dams is approximately 2,000 acre feet with the pond elevation at the top of the dams. The height of the Northern dam is 23 feet from the original downstream toe stream channel to the top of the dam. The dam is, therefore, in the INTERMEDIATE size category according to the Corps of Engineers' Recommended Guidelines.

(d) Hazard Classification

The hazard potential classification for the Northern dam is LOW because of the slight economic losses and very low potential for loss of life downstream which may occur in the event of dam failure. No houses are endangered by a dam failure and the only significant damage is the culvert crossing East Otis Road. Section 5 of this report presents more detailed discussion of the hazard potential.

(e) Ownership

The dam is owned by Lost Wilderness, Inc. of Tolland, Massachuetts. The Woronoco Savings Bank in Westfield, Massachusetts is handling all the affairs of the subdivision at this date. Inquiries should be made to Mr. Mahoney at the Woronoco Savings Bank by telephone at 413-568-9141.

(f) Operator

Apparently, the operator of the Northern Dam is Lost Wilderness, Inc. of Tolland, Massachusetts. According to Mr. Mahoney of the Woronoco Savings Bank, the corporation is not very active and he is not aware of any operation and maintenance done by the corporation.

(g) Purpose of the Dam

The purpose of the dam is recreational. Lost Wilderness Lake was designed to be the center of a recreational community. The area was subdivided and some property has been sold. However, very little of the surrounding area has been developed.

(h) Design and Construction History

The dam was designed by Brown, Moynihan & Associates, Inc. of Lee, Massachusetts and construction was completed in 1976.

(i) Normal Operating Procedure

The dam is self regulating. The only means of draining the pond is to open the sluice gate at the Twining Pond Dam.

1.3 Pertinent Data

(a) Drainage Area

The drainage area for this dam covers approximately 1.22 square miles. It is made up primarily of rolling hills with a small section of fresh water marsh. The hills are wooded with some pasture and minor development.

(b) Discharge at Damsite

1) Outlet Works

Normal discharge at the site is via the inlet at elevation 1,349.0 to the principal spillway and through the 10 inch diameter outlet pipe to the downstream channel. In the event of severe flood flows, excess flow would discharge over the emergency spillway at elevation 1351.0 feet (MSL). The test flood would flow through the spillway facilities at both the Twining Pond Dam and the Northern Dam. (See calculations in Appendix D.)

2) Maximum Known Flood at Damsite

There is no data available for the maximum known flood at this damsite.

3) Ungated Spillway Capacity at Top of Dam

The capacity of the principal spillway with the reservoir at top of dam elevation (1355.5 feet MSL-NGVD) is approximately 11 cfs. The capacity of the emergency spillway is approximately 745 cfs at this level.

4) Ungated Spillway Capacity at Test Flood

The capacity of the principal spillway with the reservoir at test flood elevation (1,352.3 feet MSL-NGVD) is approximately 11 cfs. The capacity of the emergency spillway is approximately 149 cfs at this level.

5) Gated Spillway Capacity at Normal Pool Elevation

There are no gated spillways associated with this structure.

6) Gated Spillway Capacity at Test Flood Elevation

There are no gated spillways.

7) Total Spillway Capacity at Test Flood Elevation

The total spillway capacity for this dam at test flood elevation (1,352.3 feet MLS-NGVD) is approximately 160 cfs. (Southern dam spillway capacity is approximately 800 cfs for a combined capacity of 960 cfs.)

8) Total Project Discharge at Top of Dam

The total project discharge at top of dam (1,355.5 feet MSL-NGVD) is approximately 756 cfs. (Twining Pond Dam discharge is approximately 4,384 cfs for combined discharge of 5,140 cfs)

9) Total Project Discharge at Test Flood Elevation

The total project discharge at test flood elevation (1,352.3 feet MSL-NGVD) is approximately 160 cfs. (Twining Pond Dam discharge is approximately 800 cfs for a combined discharge of 960 cfs.)

(c) Elevation (ft. above MSL-NGVD)

1) Streambed at toe of dam: 1,332.5±

2) Bottom of cutoff: 1,335±

3) Maximum tailwater: unknown

4) Normal pool: 1,349.0

5) Full flood control pool: Not applicable.

6) Emergency spillway crest (no gates): 1,351.0 (both dams)

7) Design surcharge (Original Design): unknown

8) Top of dam: 1,355.5 (both dams)

9) Test flood design surcharge: 1,352.3

(d) Reservoir (Length in feet)

1) Normal pool: 3,300±

2) Full flood control pool: Not applicable.

3) Emergency spillway crest pool: 3,360±

4) Top of dam: 3,500±

5) Test flood pool: 3,400±

(e) Storage (acre-feet)

1) Normal pool: 1,200±

2) Full flood control pool: Not applicable.

3) Spillway crest pool: 1,400±

4) Top of dam: 2,000±

5) Test flood pool: 1,600±

(f) Reservoir Surface (acres)

1) Normal pool: 100

2) Full flood control pool: Not applicable.

3) Spillway crest: 116

4) Test flood pool: 130

5) Top of dam: 150

(g) Dam

	Dike
1) Type: Earth Embankment	Earth Embankment

2)	Length: 240 ft.	400 ft.
3)	Height: 23 ft.	8± ft.
4)	Top Width: 15 ft.	15 ft.
5)	Side Slopes: Upstream 3 to 1 Downstream 3 to 1	same
6)	Zoning: More Pervious Soil Borrow (Gravel or Sand Borrow - GP, GW, SP or SW)	Same
7)	Impervious Core: More Impervious Soil Borrow (SM or GM)	Same
8)	Cutoff: More Impervious Soil Borrow (SM or GM)	Unknown
9)	Grout curtain: None	None

(h) Diversion and Regulating Tunnel

Not applicable

(i) Spillway

1) Type:

a)	Principal spillway:	Reinforced concrete drop inlet
b)	Emergency spillway:	Grass covered, earth excavated channel with level control section.

2) Length of weir:

a)	Principal spillway inlet:	3 feet
b)	Emergency spillway:	30 feet

3) Crest elevation:

a)	Principal spillway inlet:	1,349.0
b)	Emergency spillway:	1,351.0

4) Gates: None

5) Upstream Channel:

a)	Principal spillway:	Reservoir
b)	Emergency spillway:	Grass covered earth excavated channel 80± ft. to control section.

6) Downstream Channel:

a) Principal spillway: Small, unlined plunge pool and narrow channel through moderately sloping woodland.

b) Emergency spillway: Grass covered, earth cut and fill channel with level control section.

(j) Regulating Outlets

1) Invert: 1,346.2 feet MSL

2) Size: 10-inch

3) Description: 122 feet of 10" Class 150 Asbestos Cement Pipe

4) Control Mechanism: None at this location. See Lost Wilderness Lake Twining Pond Dam (MA 00321) for description of pond drain.

SECTION 2 - ENGINEERING DATA

2.1 Design Data

Some design data, including hydrologic computations for the watershed and hydraulic computations for the Twining Pond Dam only, as well as some soils testing at both sites, some seepage calculations and reinforced concrete structural design computations were available for review at the offices of Robert G. Brown and Associates, Inc., Pittsfield, Massachusetts.

2.2 Construction Data

The design plans available for this dam show good agreement with the visual inspection.

Construction data was not made available for our review.

2.3 Operation Data

Since the dam is self regulating, there is no operational data available.

2.4 Evaluation of Data

The hydraulic and hydrologic design data was not sufficient to satisfy the requirements of the Corps of Engineers "Recommended Guidelines." Therefore, hydraulic and hydrologic calculations were carried out as part of this Phase I Investigation and are discussed in Section 5 and detailed in Appendix D.

Seepage and stability analyses comparable to the requirements of paragraph 4.4 of the "Recommended Guidelines" were not available for review. However, since the dam is INTERMEDIATE in size and LOW in hazard classification, and since our visual inspection showed the dam to be in generally GOOD condition such analyses are not considered necessary at this time (Ref. Par. 3.6.1 of "Recommended Guidelines.")

SECTION 3 - VISUAL INSPECTION

3.1 Findings

(a) General

The Northern Dam at Lost Wilderness Lake (Dam No. MA 01059) is in good condition, however, the emergency spillway is in fair condition at the present time.

(b) Dam

1) Earth Embankment (See photos 1, 2, 4 & 5)

The upstream slope is protected by riprap and is in good condition. There is considerable debris on the upstream slope near the entrance to the emergency spillway. An inspection of the upstream slope showed no evidence of erosion or animal borrows along the slope.

There is only one toe drain on the downstream slope and the discharge was clear. The flow from the toe drain was approximately 2 to 3 gallons per minute.

The downstream slope had some tire marks which were approximately 4 to 6 inches deep. The downstream slope showed some erosion along the entire length and greater erosion along the tire marks. There were small minor wet areas along the left toe of the dam embankment.

There is a small dike on the left side of the dam approximately 400 feet long and 8 feet high. At the downstream toe of the dike there was a small wet area, located approximately 120 feet from dam abutment.

2) Emergency Spillway (See photos 1 & 3)

The emergency spillway is in fair condition. The entrance is partially blocked with considerable debris and the channel has a few rock outcrops that were not removed during construction. These outcrops decrease the area of the spillway and will tend to collect debris near the control section.

The downstream slope is in good condition and shows no signs of erosion. There was no ponding water or any apparent wet spots. Further downstream the emergency spillway curves around the embankment and discharges to the same brook that receives the discharge of the principal spillway.

(c) Appurtenant Structure

1) Drop Inlet Principal Spillway Structure (See photo 2)

The structure is in good condition with no evidence of spalling, cracking, or efflorescence. There is no mechanical method of controlling the flow at this structure. The only way to regulate the flow is to install flashboards across the weir. At the time of this inspection there were no flashboards in use. The trash rack is in good condition and was free of debris.

2) Pond Drain Inlet Pipe

The only pond drain is located at the principal spillway of the Twining Pond Dam.

3) Outlet Conduit (See photo 6)

The downstream end of the outlet pipe is in good condition. There is no evidence of settlement or displacement of the conduit and no misalignment or cracking was evident on the inside of the pipe for those few sections that could be observed.

(d) Reservoir Area

The shore of the reservoir is generally gently sloping woodland. It appears stable and in good condition. However, there is considerable debris along the entrance to the emergency spillway.

(e) Downstream Channel (See photo 7)

The downstream channel is a narrow channel passing through moderately sloping woodland. The channel appears stable and in good condition. The plunge pool is in good condition but is not completely protected by riprap.

3.2 Evaluation

The dam and outlet conduit are in good condition. The emergency spillway is in fair condition. The potential problems noted during the visual inspection are listed below.

a) Tire ruts and erosion on the downstream face of the dam embankment.

b) Debris on the upstream dam embankment slope and at the entrance to the emergency spillway.

c) A few, minor wet areas along the left toe of the dam embankment.

d) Rock outcrops in the emergency spillway were not removed during construction and therefore the spillway cross section does not agree with the design.

e) Some settlement along the top of the dike.

f) One wet spot was noticed along the downstream toe of the dike approximately 120 feet from its easterly abutment.

SECTION 4 - OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

(a) General

No written operational procedures are available for this dam. The dam is self regulating.

(b) Description of Any Warning System in Effect

There is no written warning system in effect.

4.2 Maintenance Procedures

(a) General

There are no formal maintenance procedures for the Northern Dam at Lost Wilderness Lake. It has been reported that there has been no maintenance on this dam since it has been constructed.

(b) Operating Facilities

The dam is self regulating and there are no facilities that require periodic operation.

4.5 Evaluation

Detailed operating procedures are not considered necessary since the dam is self regulating.

A program of annual technical inspections should be established and regular maintenance should be carried out.

A downstream emergency flood warning system should be developed.

SECTION 5 - EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General

The Northern Dam at Lost Wilderness Lake is in the watershed of the West Branch of the Farmington Rver. The dam is located approximately 1.3 miles upstream of the confluence of an unnamed brook and the West Branch of the Farmington River. The upstream drainage area is approximately 1.22 square miles with rolling topography.

The dam itself is a 240 foot long earthen embankment with a grass-lined earth emergency spillway, 30 feet wide at the control section. The principal spillway consists of one orifice located on a reinforced concrete drop inlet riser on the upstream face of the embankment. Flow from the orifice proceeds under the dam through an asbestos-cement pipe.

5.2 Design Data

The design data made avilable for this review was insufficient to determine all hydraulic and hydrologic features of the Northern Dam. The dam was designed by Brown, Moynihan & Associates, Inc. and their design plans show the elevation of the normal pool to be at 1,349.0 feet MSL. The emergency spillway crest was set at 1,351.0 feet MSL and the top of the dam was set at 1,355.5 feet MSL.

5.3 Experience Data

No records of flow or stage are known to be available for the Northern Dam (No. MA 00321).

5.4 Test Flood Analysis

The hydrologic conditions of interest in this Phase I investigation are those required to assess the dam's overtopping potential and its ability to safely allow an appropriately large flood to pass. This requires using the discharge and storage characteristics of the structure to evaluate the impact of an appropriately sized Test Flood. The original hydraulic and hydrologic design calculations have not been made available for inclusion in this Report.

Guidelines for establishing a recommended Test Flood based on the size and hazard classification of a dam are specified in the "Recommended Guidelines" of the Corps of Engineers. The impoundment of between 1,000 and 50,000 acre feet and the height of less than 100 feet classify this dam as an INTERMEDIATE size structure

The appropriate hazard classification for this dam is LOW because of the very slight economic losses and small potential for loss of life downstream in the event of dam failure. As shown in the Dam Failure Analysis section, the increase in flooding caused by failure would not pose a threat to life and property at downstream locations. (See Dam Failure Analysis section.)

As shown in Table 3 of the Corps of Engineer's "Recommended Guidelines," the appropriate Test Flood for a dam classified as INTERMEDIATE in size with a LOW hazard potential would be one half the probable maximum flood (1/2 PMF). The Corps of Engineers' "Maximum Probable Peak Flow Rates" curve using rolling topography gives a PMF of 2,280 cfs/sq. mi. for a drainage area of 1.22 square miles. Therefore, the probable maximum flood is 2,780 cfs for this drainage area and one half the probable maximum flood is 1,390 cfs.

When this test flood is routed through the reservoir, the resultant outflow from the combined spillways is 960 cfs. The spillways of both the Twining Pond Dam and the Northern Dam would be available to discharge the test flood. The Northern Dam spillway will discharge approximately 160 cfs, and the Twining Pond dam spillway will discharge approximately 800 cfs of the routed test flood. The depth of flow at the control sections of the spillways at the test flood conditions would be approximately 1.3 feet. Therefore, the existing spillway capacity can accommodate one half the Probable Maximum Flood with a freeboard of 3.2 feet remaining to the top of the dam.

5.5 Dam Failure Analysis

A dam failure analysis using the procedures in the Corps of Engineers, "Rule of Thumb Guidance for Estimating Downstream Failure Hydrographs" dated April 1978, was performed for the Northern Dam of Lost Wilderness Lake.

For an assumed breach equal to 40% of the dam's length computed at half height, the breached length is 46 feet. The resulting dam failure flow using a water depth of 19.8 feet is 6,800 CFS. 19.8 feet represents the depth of water upstream of the dam calculated at the test flood pond elevation. The test flood spillway outflow is 160 CFS. The Southern dam (Twining Pond Dam) will simultaneously discharge approximately 800 cfs for a combined spillway outflow of 960 cfs.

The first damage area impacted by dam failure flow is directly downstream of the dam. Prior to dam breach, the test flood flow is 160 CFS resulting in a river stage of about 1.0 foot. The dam failure flow is 6,800 CFS resulting in a river stage of about 7.6 feet. There are no structures or developments directly downstream of the dam, therefore, the damage incurred will not be significant.

The second damage area impacted by dam failure flow is the crossing of East Otis Road which is approximately 300 feet downstream of the dam. Prior to dam breach, the test flood flow is 160 CFS which exceeds the capacity of the culvert and results in overtopping the road by about 0.3 foot. The dam failure attenuated flow is 6790 CFS which results in overtopping the roadway by about 4.7 feet. Pre-failure flooding is minor, however, post-failure flooding has a high potential for severe damage to the roadway crossing. East Otis Road is a secondary gravel surfaced roadway.

The third damage area impacted by dam failure flow is the confluence of the discharge stream with the West Branch of the Farmington

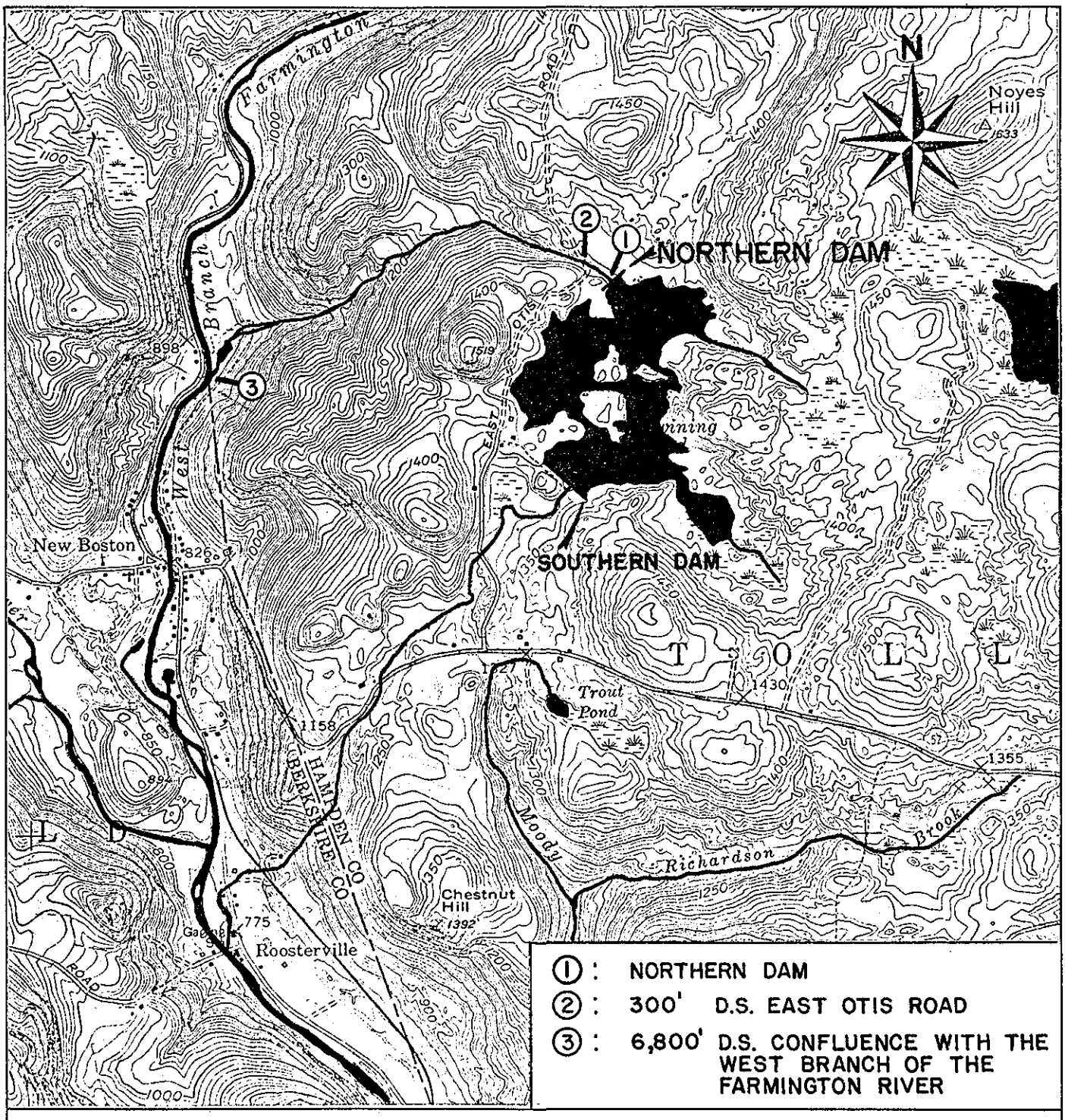
River approximately 6,800 feet downstream of the dam. At this location, Route 8 parallels the West Branch of the Farmington River on the west side opposite from the confluence area. There are 3 houses on the west side of Route 8 which are about 12 feet above the River channel.

Prior to dam breach the test flood outflow from the dam is 160 CFS. 50% of a PMF test flood for the West Branch of the Farmington River at this location is about 34,000 CFS. 160 CFS results in a river stage of less than 1.0 foot while 34,000 CFS results in a river stage of about 10.8 feet. The West Branch of the Farmington River 1/2 PMF test flood flow will cause some minor flooding of Route 8, but does not threaten the houses. The dam failure attenuated flow is 6,700 CFS which by itself results in a river stage of about 4.1 feet, and in combination with the 1/2 PMF river test flood flow about 11.8 feet. By itself, the dam failure flow does not constitute a hazard to the Route 8 roadway or the houses. In combination with a significant flood occurrence, the dam failure flow does not add significantly to the potential for damage.

Downstream of the confluence, the dam failure flow will be quickly attenuated and will not constitute a hazard to lives or property.

In summary, the only significant damage attributable to a Lost Wilderness Northern Dam failure is the culvert crossing of East Otis Road. No structures are damaged and no lives are threatened by the dam failure flows.

The following chart summarizes the downstream impacts of the failure of the Northern Dam No. MA 01059.



① : NORTHERN DAM

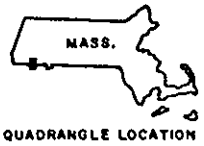
② : 300' D.S. EAST OTIS ROAD

③ : 6,800' D.S. CONFLUENCE WITH THE WEST BRANCH OF THE FARMINGTON RIVER

- SCALE -

1000' 0 1000' 2000' 3000'

FROM: U.S.G.S. TOLLAND CENTER, MASS.-CONN. QUADRANGLE MAP



QUADRANGLE LOCATION

TIGHE & BOND / SCI CONSULTING ENGINEERS EASTHAMPTON, MASS.	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION AND DOWNSTREAM HAZARD MAP

NORTHERN DAM (MA 01059)
LOST WILDERNESS LAKE
HAMPDEN COUNTY

TOLLAND
MASSACHUSETTS

			SCALE: AS NOTED
			DATE : DECEMBER 1979

PROBABLE DOWNSTREAM IMPACT BEFORE AND AFTER DAM FAILURE

Lost Wilderness Northern Dam MA 01059

	Location	No. of Houses	Other Damage	Flow Rates Before Failure CFS	Flow Rates After Failure CFS	River Stage Before Failure FT.	River Stage After Failure FT.	Comments
1.	Downstream of Dam.	0	---	160	6,800	1.0	7.6	No Significant Damage
2.	300' D.S. East Otis Rd.	0	Culvert	160	6,790	3.8	7.6	Minor flooding of road before failure: after failure road overtopped 4.1 ft.
3.	6,800' D.S. Confluence with West Branch of Farmington River	0	---	160 34,000*	6,790 41,790*	1.0 10.8*	4.1 11.8*	Dam failure flow not significant.

* 50% of PMF for West Branch of Farmington River at confluence.

SECTION 6 - EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations

There has been no significant displacement or distress which would warrant the preparation of structural stability calculations.

6.2 Design and Construction Data

The design material made available for this review was insufficient to determine the structural stability of the embankment.

Some field testing was carried out during the construction phase including a few sieve analyses and compaction tests.

A review of the structural calculations for the design of the drop inlet principal spillway structure indicate that this structure has been designed on the basis of sound engineering practice.

6.3 Post Construction Changes

There have been no known modifications since the work was completed in 1976.

6.4 Seismic Stability

The Northern Dam is located in seismic zone 1. According to the recommended Corps. of Engineers' guidelines, a seismic analysis is not warranted.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

(a) Condition

The dam and its appurtenances are generally in good condition at the present time with the exception of the emergency spillway which is in fair condition.

(b) Adequacy of Information

There is insufficient design and construction data to permit an assessment of dam safety.

(c) Urgency

The recommendations and remedial measures described herein should be implemented by the owner within one year of receipt of this Phase I Inspection Report.

7.2 Recommendations

The recommendations of this Phase I investigation are that the following studies and actions be carried out under the supervision of a qualified, registered professional engineer:

(a) Remove the ledge outcrops from the emergency spillway to comply with the design plans.

(b) Determine the cause of the wet area along the downstream toe of the dike approximately 120 feet from its easterly abutment and what corrective measures, if any, are required.

(c) Determine the cause of the wet areas along the left toe of the dam embankment and what corrective measures, if any, are required.

(d) Determine the need for a low level drain at this dam, since the drain at the Twining Pond Dam may not completely drain the area behind the Northern Dam.

7.3 Remedial Measures

The recommendation of this Phase I investigation is that the following remedial and/or maintenance items be carried out:

(a) Implement and intensify a program of diligent and periodic maintenance including, but not limited to: mowing embankment slopes; backfilling drainage gullies and tire ruts with suitable, well tamped soil; and clearing debris from the trash racks and the entrance to the emergency spillway.

(b) Fill low areas on the top of the dike.

(c) Institute a program of annual technical inspections.

7.4 Alternatives

There are no meaningful alternatives to the above recommendations.

APPENDIX A

INSPECTION CHECKLIST

INSPECTION CHECK LIST

PARTY ORGANIZATION

PROJECT Lost Wilderness Lake Dam No. MA 00321
Northern Dam
Tolland, Massachusetts

DATE 10/31/79

TIME 11:30 A.M.

WEATHER Sunny & Clear

W.S. ELEV. _____ U.S. _____ DN.S.

PARTY:

1.	J.W. Powers	T & B/SCI	
2.	G.H. McDonnell	T & B/SCI	
3.	E.A. Moe	T & B/SCI	
4.	H.A. Koski	T & B/SCI	
5.	O.H. Dumais	T & B/SCI	
6.			
7.			
8.			
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10.			

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	All project features were inspected by all party members.		
2.			
3.			
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/

INSPECTION CHECK LIST

PROJECT Lost Wilderness Lake Dam No. MA 00321 DATE 10/31/79

PROJECT FEATURE Northern Dam NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	1355.5. ft. MSL (from Design Plans)
Current Pool Elevation	1349 ft. MSL (from Design Plans)
Maximum Impoundment to Date	Unknown
Surface Cracks	None
Pavement Condition	None
Movement or Settlement of Crest	None Apparent
Lateral Movement	None Apparent
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Not Applicable
Indications of Movement of Structural Items on Slopes	No apparent movement
Trespassing on Slopes	Tire ruts on downstream face of embankment
Vegitation on Slopes	Grass on all slopes
Sloughing or Erosion of Slopes or Abutments	Some erosion on downstream face of embankment
Rock Slope Protection - Riprap Failures	Rip rap on upstream slope for erosion protection-see plans for detail. No apparent rip rap failures
Unusual Movement or Cracking at or near Toes	None Apparent
Unusual Embankment or Downstream Seepage	A minor wet spot along left toe of dam.
Piping or Boils	None Apparent
Foundation Drainage Features	Toe Drain
Toe Drains	One -4" pipe steady clear flow 2± gpm
Instrumentation System	None

INSPECTION CHECK LIST

PROJECT Lost Wilderness Lake Dam No. MA 00321 DATE 10/31/79

PROJECT FEATURE Northern Dam NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	Reservoir
Slope Conditions	Not Applicable
Bottom Conditions	Not Applicable
Rock Slides or Falls	Not Applicable
Log Boom	Not Applicable
Debris	Debris floating in Reservoir
Condition of Concrete Lining	Not Applicable
Drains or Weep Holes	Not Applicable
b. Intake Structure	
Condition of Concrete	Good - no spalling or discoloration
Stop Logs and Slots	No stop logs No slots

INSPECTION CHECK LIST

PROJECT Lost Wilderness Lake Dam No. MA 00321 DATE 10/31/79

PROJECT FEATURE Northern Dam NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	
General Condition	Good
Condition of Joints	None
Spalling	None Apparent
Visible Reinforcing	None Apparent
Rusting or Staining of Concrete	None Apparent
Any Seepage or Effloresecence	None Apparent
Joint Alignment	Not Applicable
Unusual Seepage or Leaks in Gate Chamber	No gate chamber
Cracks	None Apparent
Rusting or Corrosion of Steel	None Apparent
b. Mechanical and Electrical	No mechanical or electrical equipment at this site.
Air Vents	
Float Wells	
Crane Hoist	
Elevator	
Hydraulic System	
Service Gates	
Emergency Gates	
Lightning Protection System	
Emergency Power System	
Wiring and Lighting System in Gate Chamber	

INSPECTION CHECK LIST

PROJECT Lost Wilderness Lake Dam No. MA 00321 DATE 10/31/79

PROJECT FEATURE Northern Dam NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	
General Condition of Concrete	Not accessible; could not inspect
Rust or Staining on Concrete	Not Applicable
Spalling	Not Applicable
Erosion or Cavitation	Not Applicable
Cracking	Not Applicable
Alignment of Monoliths	Not Applicable
Alignment of Joints	Good -10" A.C. pipe can see daylight at inlet from headwall. First 2 joints dry, no cracking or misalignment.
Numbering of Monoliths	Not Applicable

INSPECTION CHECK LIST

PROJECT Lost Wilderness Lake Dam No. MA 00321 DATE 10/31/79

PROJECT FEATURE Northern Dam NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Concrete	Headwall is in good condition
Rust or Staining	None Apparent
Spalling	None Apparent
Erosion or Cavitation	None Apparent
Visible Reinforcing	None Apparent
Any Seepage or Efflorescence	None Apparent
Condition at Joints	Good
Drain holes	Toe drain in good condition
Channel	
Loose Rock or Trees Overhanging Channel	Plunge pool is not completely protected by rip rap
Condition of Discharge Channel	Channel is a small stream approximately 3 feet wide. The stream flows through a gently sloping area of tall grass and brush. About 300 feet from headwall is East Otis Road and beyond that the area is heavily wooded.

INSPECTION CHECK LIST

PROJECT Lost Wilderness Lake Dam No. MA 00321 DATE 10/31/79

PROJECT FEATURE Northern Dam NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	Emergency Spillway
a. Approach Channel	
General Condition	Filled with debris - logs, stumps, etc.
Loose Rock Overhanging Channel	Rock outcrops in entrance and extending out from the northerly sidewall.
Trees Overhanging Channel	There are no trees in this area
Floor of Approach Channel	Grass floor covered with debris and rock outcrops constrict the channel-does not conform to design plans
b. Weir and Training Walls	
General Condition of Concrete	Not Applicable
Rust or Staining	Not Applicable
Spalling	Not Applicable
Any Visible Reinforcing	Not Applicable
Any Seepage or Effloresence	Not Applicable
Drain Holes	Not Applicable
c. Discharge Channel	
General Condition	Good
Loose Rock Overhanging Channel	Minor rock outcrops
Trees Overhanging Channel	None
Floor of Channel	Grass
Other Obstructions	Roadway downstream with 30" culvert

Grass covered earthen dike becomes the northerly sideslope of the emergency spillway

INSPECTION CHECK LIST

PROJECT Lost Wilderness Lake Dam No. MA 00321 DATE 10/31/79

PROJECT FEATURE Northern Dam NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - SERVICE BRIDGE	
a. Super Structure	Not Applicable
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	
Under Side of Deck	
Secondary Bracing	
Deck	
Drainage System	
Railings	
Expansion Joints	
Paint	
b. Abutment & Piers	
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Condition of Seat & Backwall	

INSPECTION CHECK LIST

PARTY ORGANIZATION

PROJECT Lost Wilderness Lake Dam No. MA01059
Northern Dike
(at Northern Dam)
Tolland Massachusetts

DATE 10/31/79

TIME 11:30 a.m.

WEATHER sunny and clear

W.S. ELEV._____ U.S._____ DN.S.

PARTY:

1. J.W. Powers, Tighe & Bond/SCI
2. G.H. McDonnell, Tighe & Bond/SCI
3. E.A. Moe, Tighe & Bond/SCI
4. H.A. Koski, Tighe & Bond/SCI
5. O.H. Dumais, Tighe & Bond/SCI
6. _____
7. _____
8. _____
9. _____
10. _____

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	All project features were inspected by all party members.		
2.			
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INSPECTION CHECK LIST

PROJECT Lost Wilderness Lake Dam No. MA 01059 DATE 10/31/79

PROJECT FEATURE Northern Dike at Northern Dam NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	1355.5 ft. MSL (from design plans)
Current Pool Elevation	1349 ft. MSL (from design plans)
Maximum Impoundment to Date	Unknown
Surface Cracks	None apparent
Pavement Condition	Not applicable
Movement or Settlement of Crest	None apparent
Lateral Movement	None apparent
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Not applicable
Indications of Movement of Structural Items on Slopes	No apparent movement
Trespassing on Slopes Vegitation on Slopes Sloughing or Erosion of Slopes or Abutments	Grass on all slopes
Rock Slope Protection - Riprap Failures	Not applicable
Unusual Movement or Cracking at or near Toes	None apparent
Unusual Embankment or Downstream Seepage	One wet spot at downstream toe of dike approx. 120 ft from easterly abutment
Piping or Boils	None apparent
Foundation Drainage Features	
Toe Drains	Not applicable
Instrumentation System	Not applicable

APPENDIX B

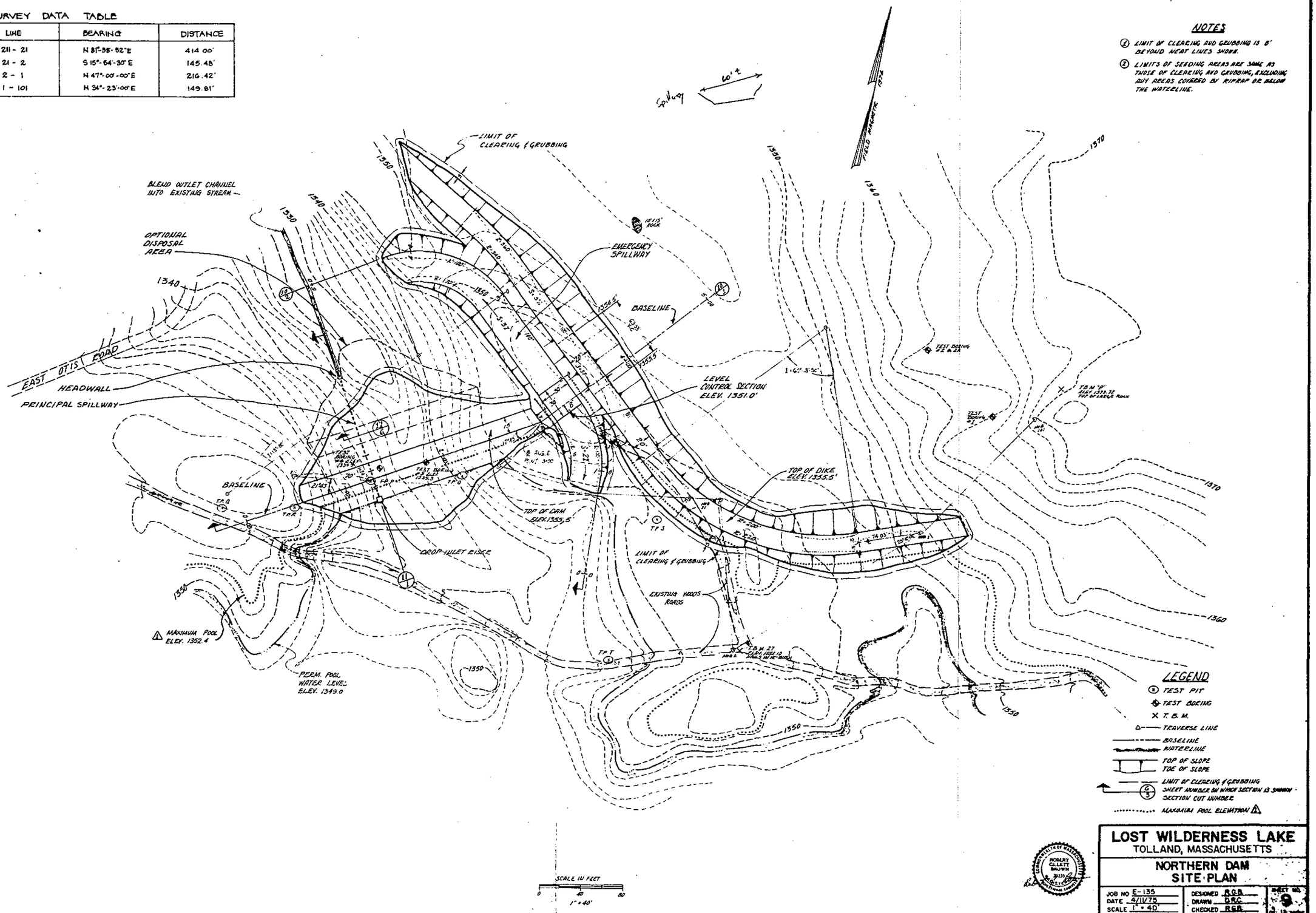
ENGINEERING DATA

SURVEY DATA TABLE

LINE	BEARING	DISTANCE
211 - 21	N 81°-58'-52"E	414.00'
21 - 2	S 15°-54'-30"E	145.48'
2 - 1	N 47°-00'-00"E	216.42'
1 - 101	N 34°-23'-00"E	149.81'

NOTES

1. LIMIT OF CLEARING AND GRUBBING IS 5' BEYOUD HEAT LINES SHOWN.
2. LIMITS OF SEEDING AREAS ARE SAME AS THOSE OF CLEARING AND GRUBBING, EXCLUDING ANY AREAS COVERED BY RIPRAP OR BELOW THE WATERLINE.



LEGEND

- TEST PIT
- TEST BORING
- X T.B.M.
- TRAVERSE LINE
- BASELINE
- WATERLINE
- TOP OF SLOPE
- TOE OF SLOPE
- LIMIT OF CLEARING & GRUBBING
- SHEET NUMBER ON WHICH SECTION IS SHOWN / SECTION CUT NUMBER
- MAXIMUM POOL ELEVATION

⚠ 6/12/75 - ADDED MAXIMUM POOL ELEVATION

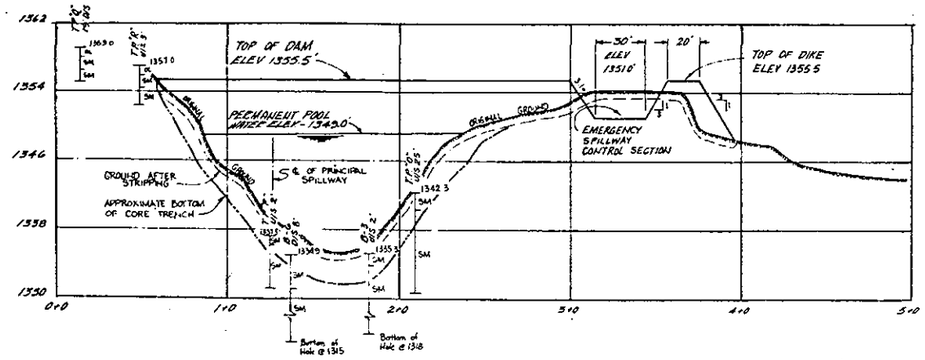
LOST WILDERNESS LAKE
TOLLAND, MASSACHUSETTS

NORTHERN DAM
SITE PLAN

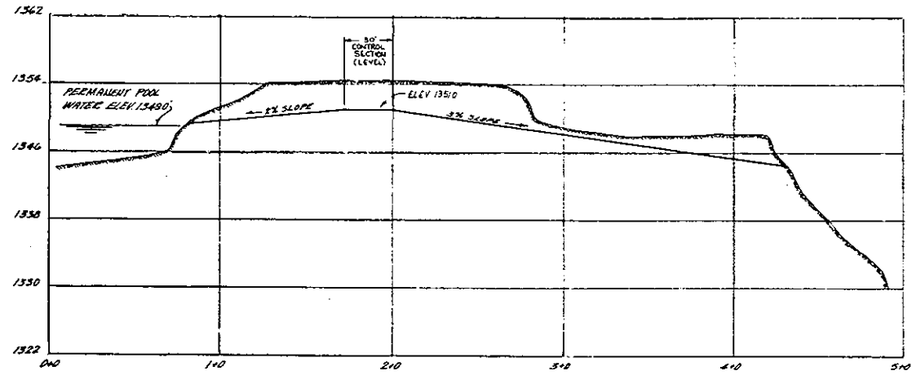
JOB NO E-135
DATE 4/11/75
SCALE 1" = 40'
DESIGNED R.G.B.
DRAWN D.R.C.
CHECKED R.G.B.
SHEET NO. 3

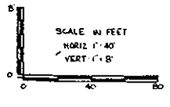
BROWN, MOYNIHAN & ASSOCIATES
ENGINEERS & SURVEYORS — ROUTE 102 — [illegible]

B-1



BASELINE PROFILE OF DAM (10/1)





PROFILE ALONG RIGHT ABUTMENT OF EMERGENCY SPILLWAY (10/2)

LOST WILDERNESS LAKE
TOLLAND, MASSACHUSETTS

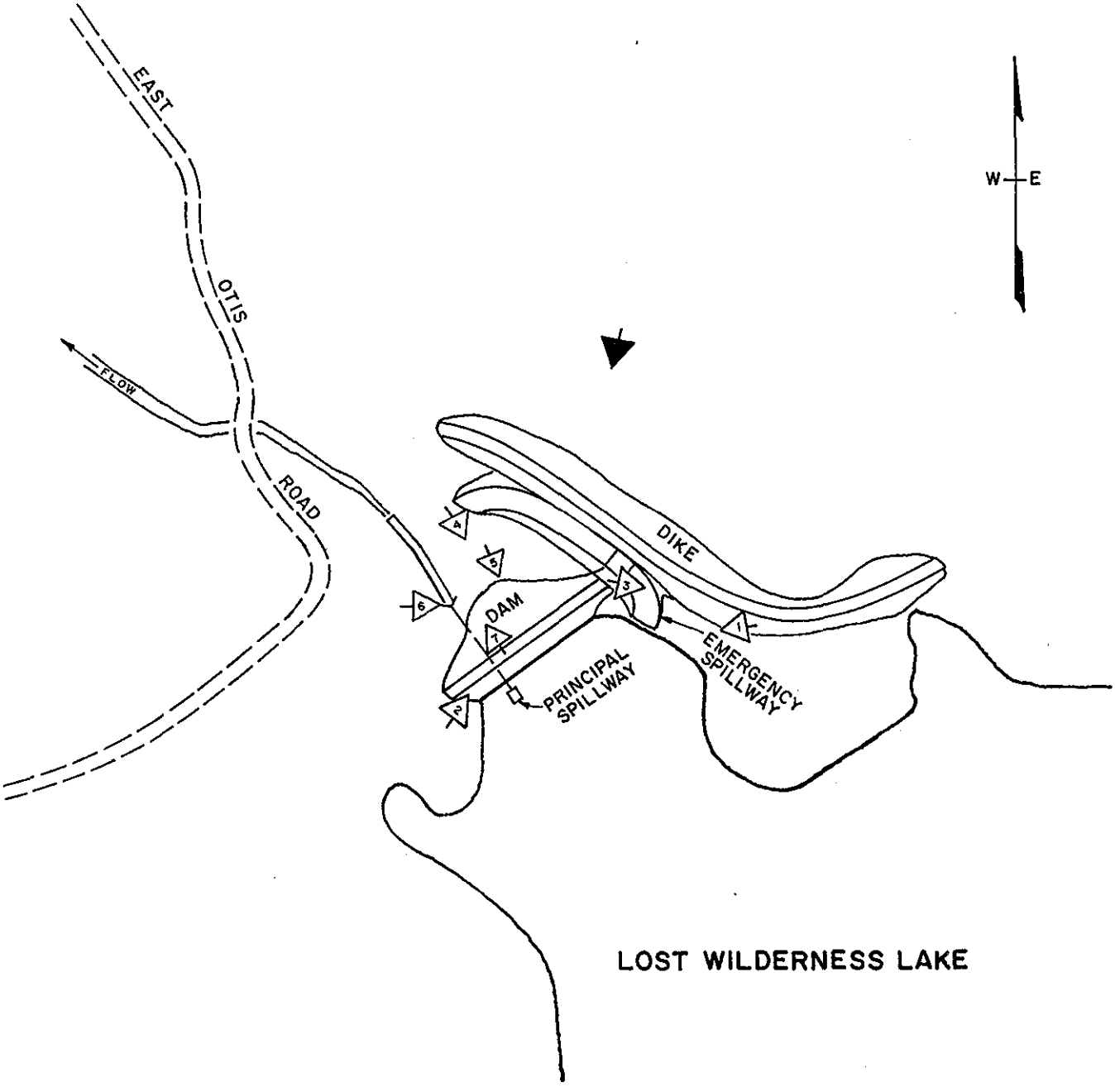
NORTHERN DAM
PROFILES

JOB NO. E-135	DESIGNED R.G.B.	SHEET NO. 10 OF 12 SHTS.
DATE 4/11/75	DRAWN R.E.H.	
SCALE AS NOTED	CHECKED R.G.B.	

BROWN, MOYNIHAN & ASSOCIATES, INC.
ENGINEERS & SURVEYORS—ROUTE 102—LEE, MASS.

APPENDIX C

PHOTOGRAPHS



NORTHERN DAM

TIGHE & BOND / SCI CONSULTING ENGINEERS EASTHAMPTON, MASS.	U.S.ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

OVERVIEW (AERIAL)

APPENDIX C

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION AND ORIENTATION OF PHOTOS

NORTHERN DAM (MA01059)
LOST WILDERNESS LAKE
HAMPDEN COUNTY

TOLLAND
MASSACHUSETTS

SCALE: NONE

DATE: DECEMBER 1979

Photo 1 - Dam overview looking westerly from dike. Note debris at entrance to the emergency spillway.

Photo 2 - Dike overview looking northerly from left abutment of dam. Note drop inlet principal spillway structure.

Photo 3 - Entrance to emergency spillway looking easterly from right side of embankment. Note debris and rock outcrop.

Photo 4 - Dam overview looking easterly from downstream slope of emergency spillway. Note tracks on downstream face of embankment.

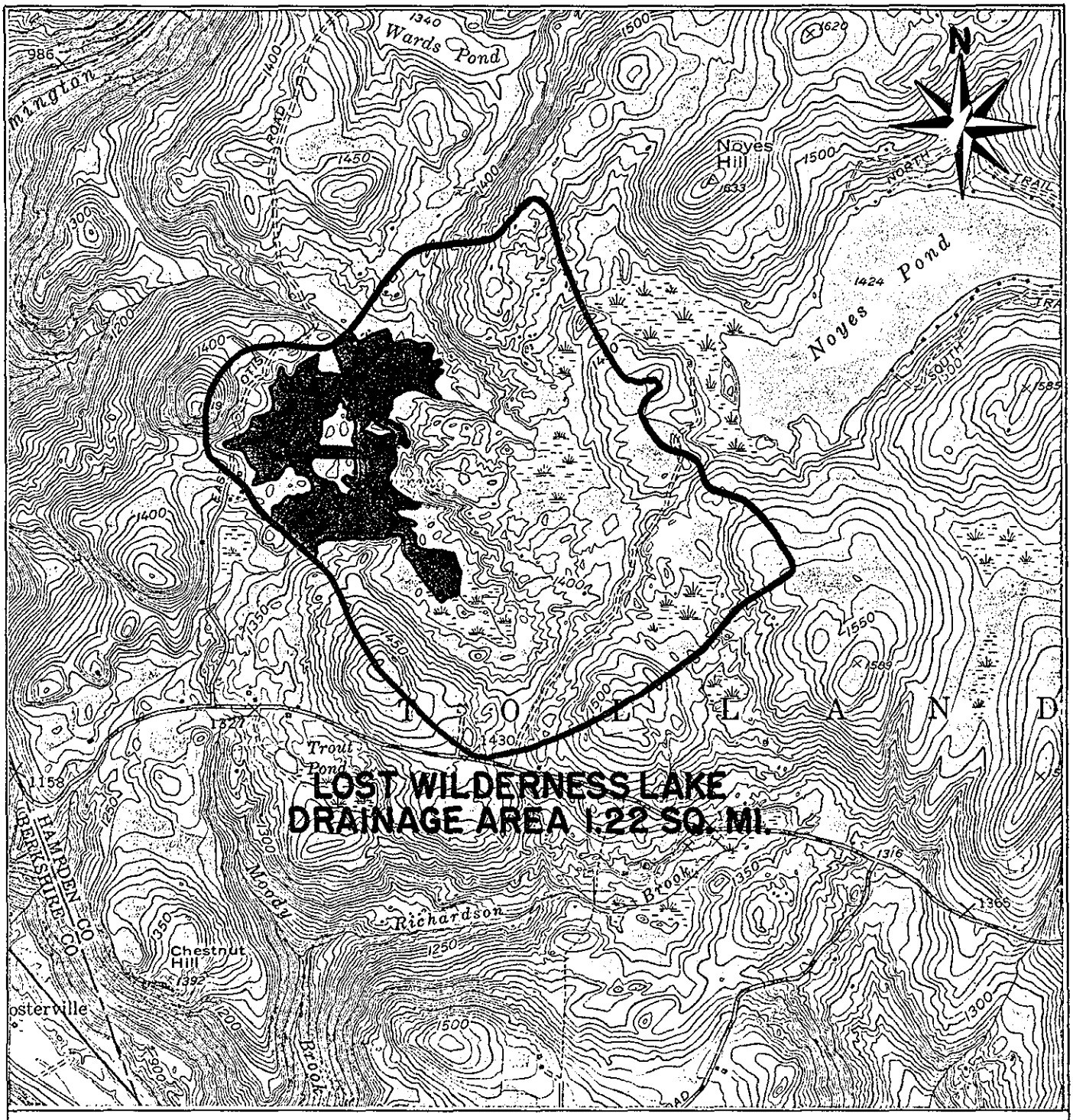
Photo 5 - Close-up of tracks on downstream face of embankment. Note additional erosion

Photo 6 - Headwall for 10-inch principal spillway pipe and toe drain, looking easterly from downstream channel.

Photo 7 - Overview of discharge channel and downstream conditions. Looking westerly from downstream slope of embankment.

APPENDIX D

OUTLINE OF DRAINAGE AREA AND HYDROLOGIC AND HYDRAULIC COMPUTATIONS



- SCALE -

1000' 0 1000' 2000' 3000'

FROM: U.S.G.S. TOLLAND CENTER, MASS.-CONN. QUADRANGLE MAP

QUADRANGLE LOCATION

TIGHE & BOND / SCI CONSULTING ENGINEERS EASTHAMPTON, MASS.	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

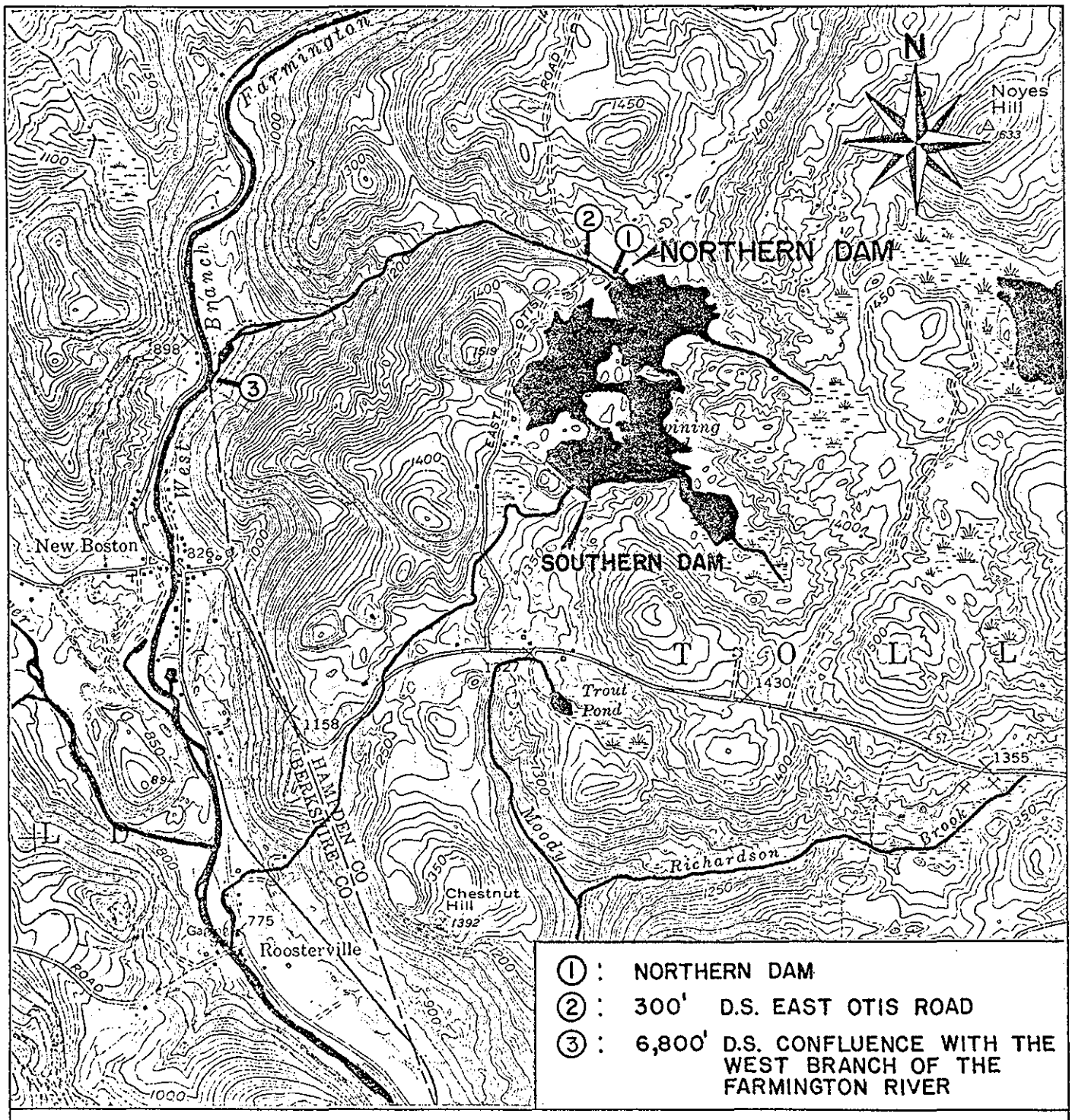
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

DRAINAGE AREA MAP

NORTHERN DAM (MA 01059)
LOST WILDERNESS LAKE
HAMPDEN COUNTY

TOLLAND
MASSACHUSETTS

			SCALE : AS NOTED
			DATE : DECEMBER 1979



-SCALE-

1000' 0 1000' 2000' 3000'

FROM: U.S.G.S. TOLLAND CENTER, MASS.-CONN. QUADRANGLE MAP

QUADRANGLE LOCATION

TIGHE & BOND / SCI CONSULTING ENGINEERS EASTHAMPTON, MASS.	U.S.ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

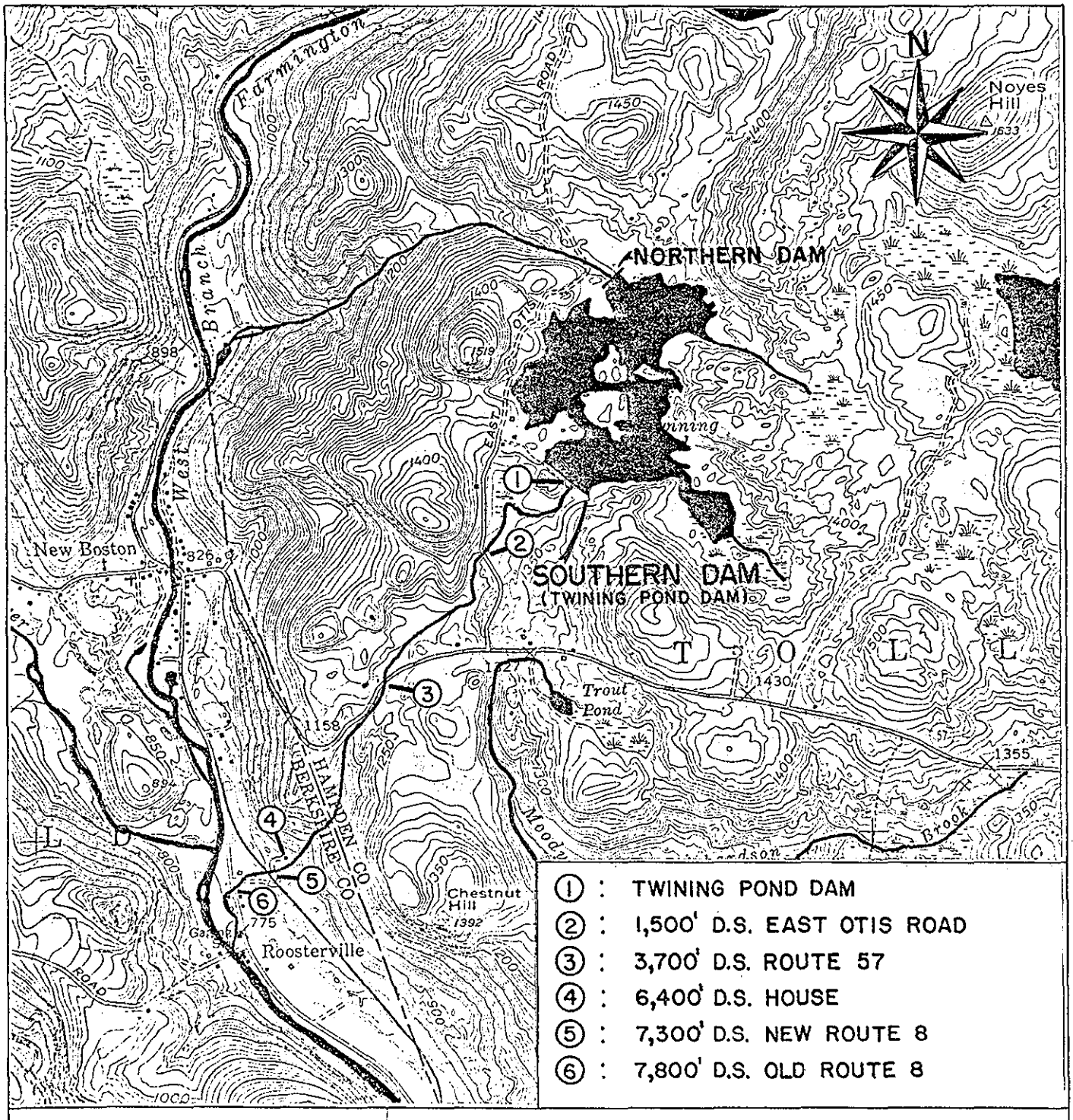
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION AND DOWNSTREAM HAZARD MAP

NORTHERN DAM (MA 01059)
LOST WILDERNESS LAKE
HAMPDEN COUNTY

TOLLAND
MASSACHUSETTS

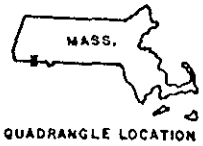
			SCALE: AS NOTED
			DATE : DECEMBER 1979



- SCALE -

1000' 0 1000' 2000' 3000'

FROM: U.S.G.S. TOLLAND CENTER, MASS.-CONN. QUADRANGLE MAP



QUADRANGLE LOCATION

TIGHE & BOND / SCI
CONSULTING ENGINEERS
EASTHAMPTON, MASS.

U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION AND DOWNSTREAM HAZARD MAP

SOUTHERN DAM (TWINING POND DAM) MA 00321
LOST WILDERNESS LAKE — TOLLAND
HAMPDEN COUNTY — MASSACHUSETTS

SCALE: AS NOTED
DATE : DECEMBER 1979

D-3

Calculations based on information from U.S.G.S. Map - Tolland Center Quad.

scale 1" = 2000'

1 sq. in = 91.83 Acres or 0.143 sq. miles.

Drainage Area

By planimeter = 1.18 sq. mi. - from Construction Plans = 1.22 sq. mi.

Use 1.22 sq. miles = 781 Acres

Surface Area of Lake

1. @ Elevation 1349 (Normal Pool Elev.)

   By planimeter = 105 Acres - from Construction Plans = 100 Acres

   Use 100 Acres

2. @ Elevation 1351 (Emergency Spillway Crest)

   Since topo is fairly uniform between 1349 & 1360 - assume straight interpolation

   $\frac{11'}{85} = \frac{2'}{x}$ $11x = 170$ $x = 15.5$ say 16 Acres; Elev 1351 → 100+16 = 116 Acres

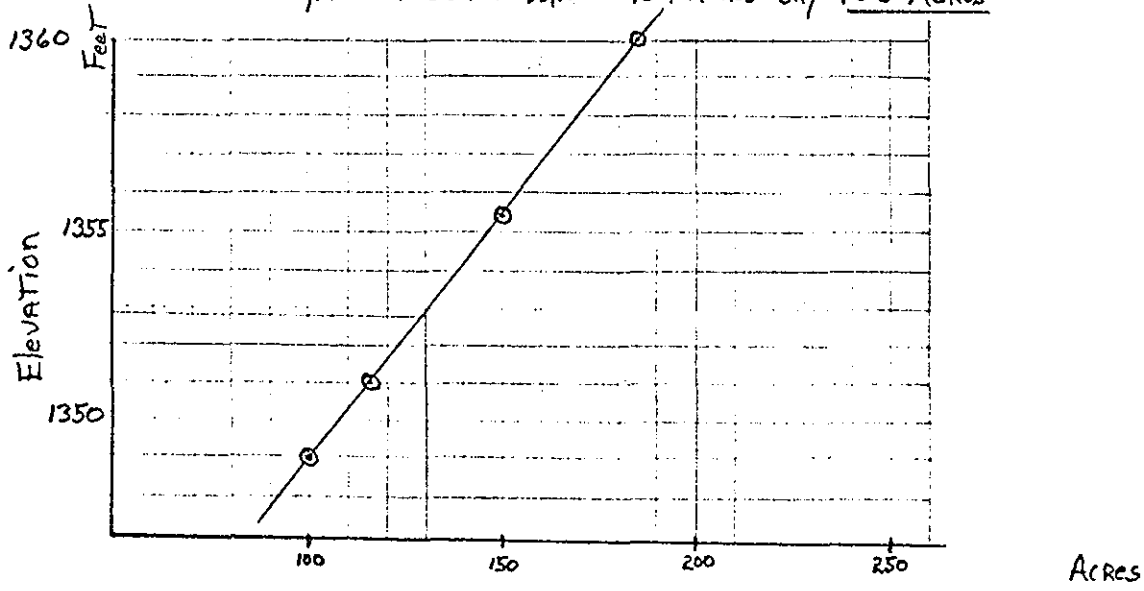
3. @ Elevation 1355.5 (Top of Dams)

   Same as No. 2 above

   $\frac{11}{85} = \frac{6.5}{x}$ $11x = 552.5$ $x = 50.2$ say 50 Acres; Elev 1355.5 → 100+50 = 150 Acres

4. @ Elevation 1360

   2.0 sq. in x 91.83 Acres/sq. in = 184+ Acres say 185 Acres

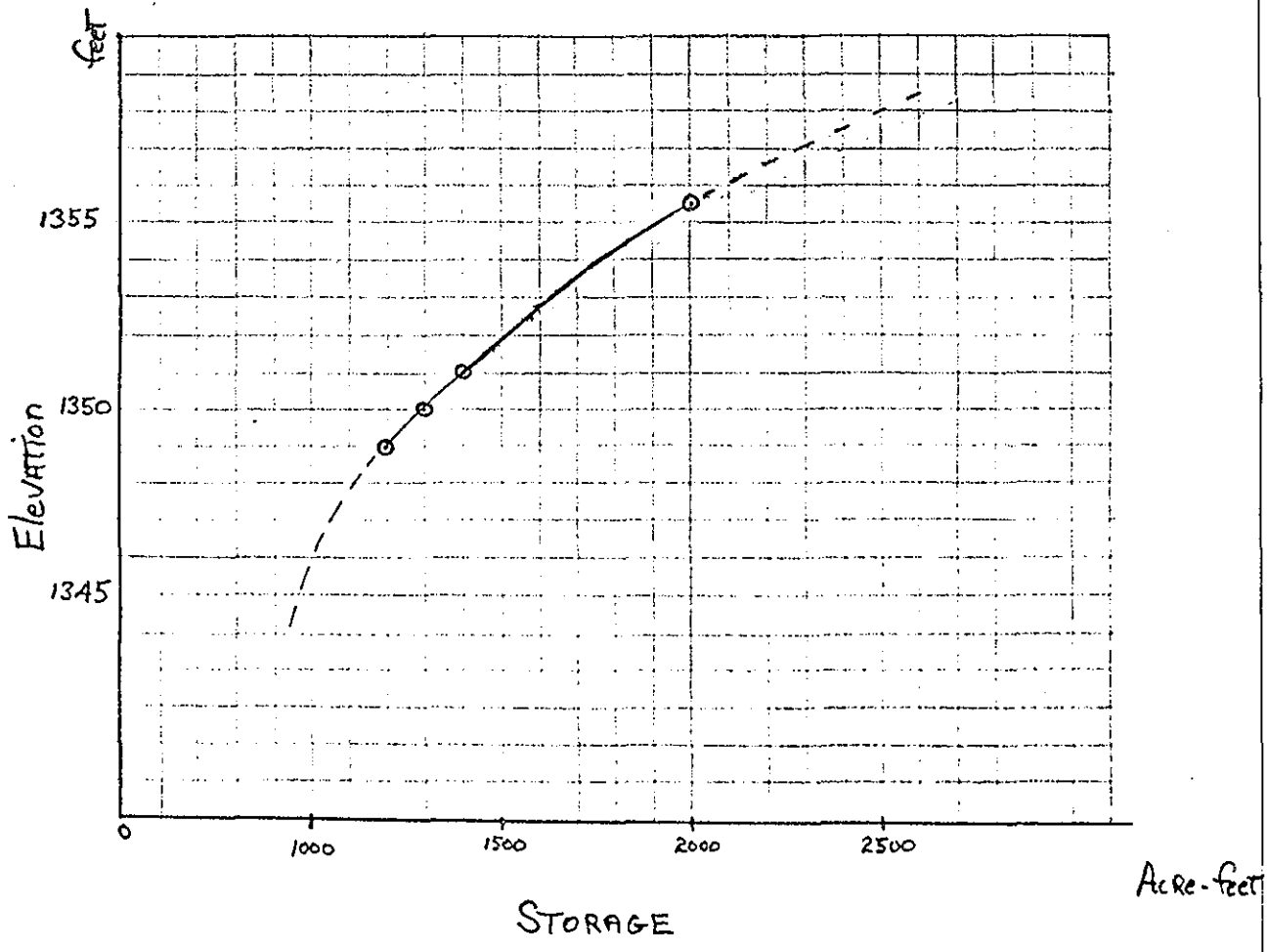


Drainage Area

Storage

Assume Avg. depth of Pond = 12' @ 1349

Elev	Area	Height (Above Normal Pool Elev.)	Storage (Approx.)
1349	100 Ac.	27' (0)	1200 Ac.-Ft.
1350	108 Ac.	28' (1)	1300 Ac.-Ft
1351	116 Ac.	29' (2)	1400 Ac.-Ft
1355.5	150 Ac.	33.5' (6.5)	2000 Ac.-Ft.



Size Classification

Height : Southern Dam (Twining Pond) 27' between 25' & 40' ∴ Small
Northern Dam 23'

Storage = 1,200± Acre-Feet @ Normal Pool — between 1000 & 50,000 ∴ Intermediate
2,000± A-F @ Top of Dam

Classification : Intermediate

Hazard Potential

Southern Dam (Twining Pond) – Significant
Northern Dam – Low

See Text For Failure analysis Description.

Test Flood

Recommended Spillway Design Flood — ½ PMF to PMF

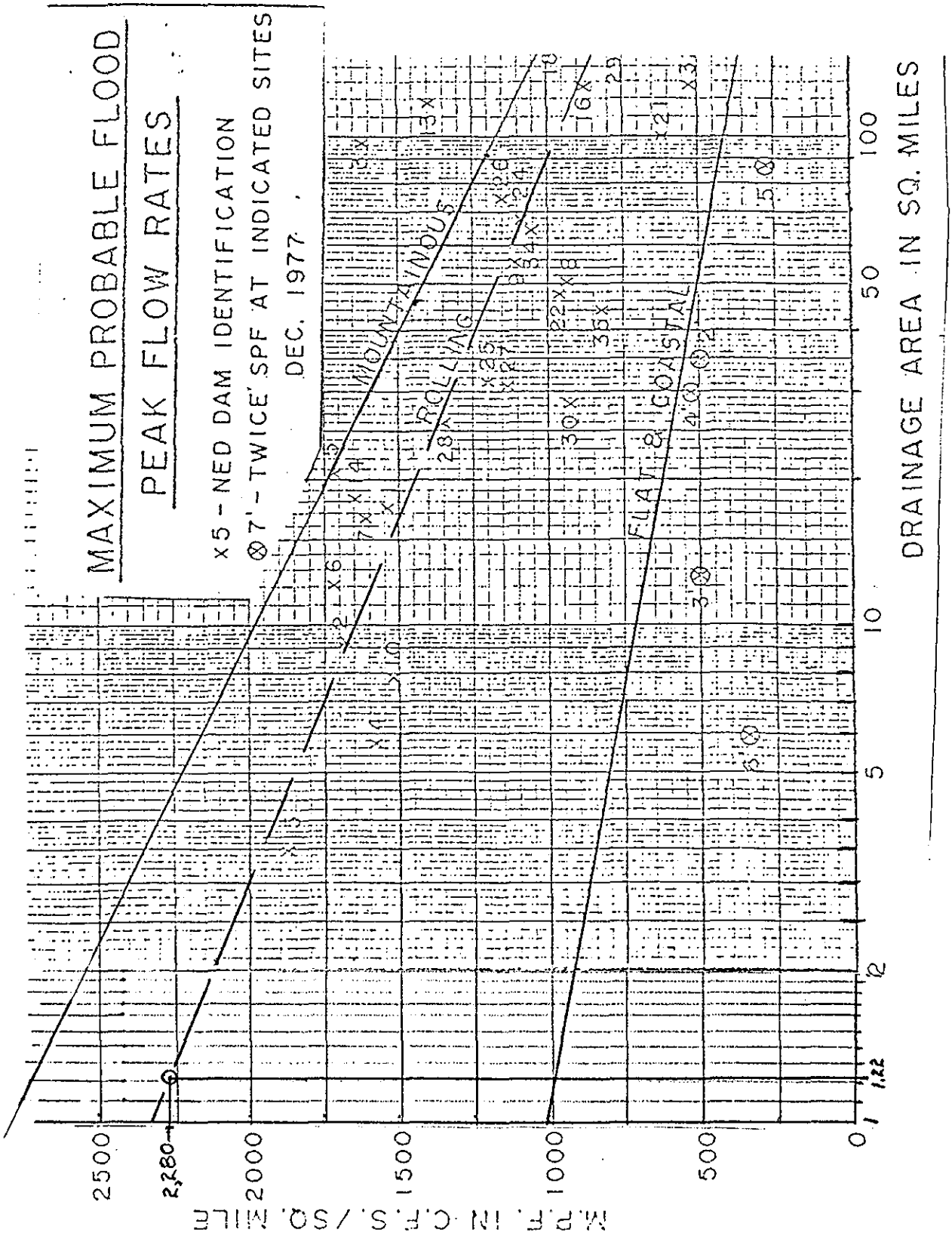
Use ½ PMF

Classification of Terrain in Drainage Area

The area is primarily Rolling terrain with a few sections of freshwater marsh. Rolling terrain will be used in determining the Peak Flow Rates.

Spillway Rating

1. Use ½ P.M.F.
2. Assume Rolling terrain
3. Drainage Area = 1.22 sq. miles
4. Use the "Maximum Probable Flood Peak Flow Rates" curves and extrapolate for a drainage area of 1.22 sq. miles.
(See next sheet)


MAXIMUM PROBABLE FLOOD
PEAK FLOW RATES
x5 - NED DAM IDENTIFICATION
⊗7' - TWICE SPF AT INDICATED SITES
DEC. 1977
MOUNTAINOUS
ROLLING
FLAT & COASTAL
2,280
M.P.F. IN C.F.S./SQ. MILE
DRAINAGE AREA IN SQ. MILES
2500
2000
1500
1000
500
0
100
50
10
5
2
1
1.22

Spillway Rating (cont.)

From curve on pg. 4 Max. Probable Flood for D.A. of 1.22 sq. mi. = 2,280 c.f.s.

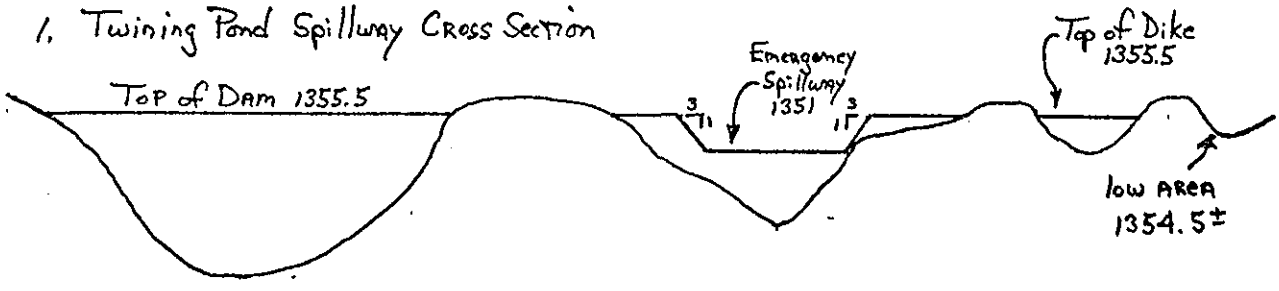
∴ ½ PMF = 2,280 ÷ 2 = 1,140 c.f.s / sq. mi

1,140 × 1.22 = 1,390 c.f.s

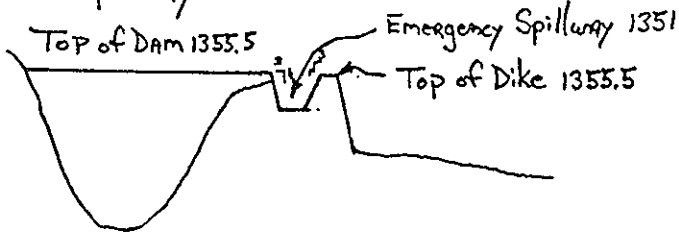
There are two dams on Lost Wilderness Lake (formerly Twining Pond.). The Twining Pond Dam is located at the southwest corner of the lake and is comprised of the dam (27 ft high), emergency spillway (grass 170'± wide), small dikes and a riser type principal spillway (2' × 10' opening). The Northern Dam is located at the northwest corner of the lake and is approx. 23 feet high with an emergency spillway (grass, 30'± wide), a dike (approx 400 ft long, 8'± high) and a riser type principal spillway (3' × 1' opening).

For these calculations we are assuming that the Test Flood will flow through both the Twining Pond spillway and the Northern spillway.

1. Twining Pond Spillway Cross Section



2. Northern Spillway Cross Section



Spillway Rating (cont.)

Stage-Discharge See pp. 8 for sample calculations

@ Twining Pond Dam

Elev.	Spillway Q_1	Emergency Spillway Q_2	Total
1349	0 c.f.s.	0 c.f.s	0 c.f.s.
1350	72 "	0 "	72 c.f.s.
1351	165 "	0 "	165 c.f.s.
1352	165 "	442 "	607 c.f.s.
1353	165 "	1,250 "	1,415 c.f.s.
1354	165 "	2,296 "	2,461 c.f.s.
1355	165 "	3,536 "	3,701 c.f.s
1355.5	165 "	4,219 "	4,384 c.f.s.

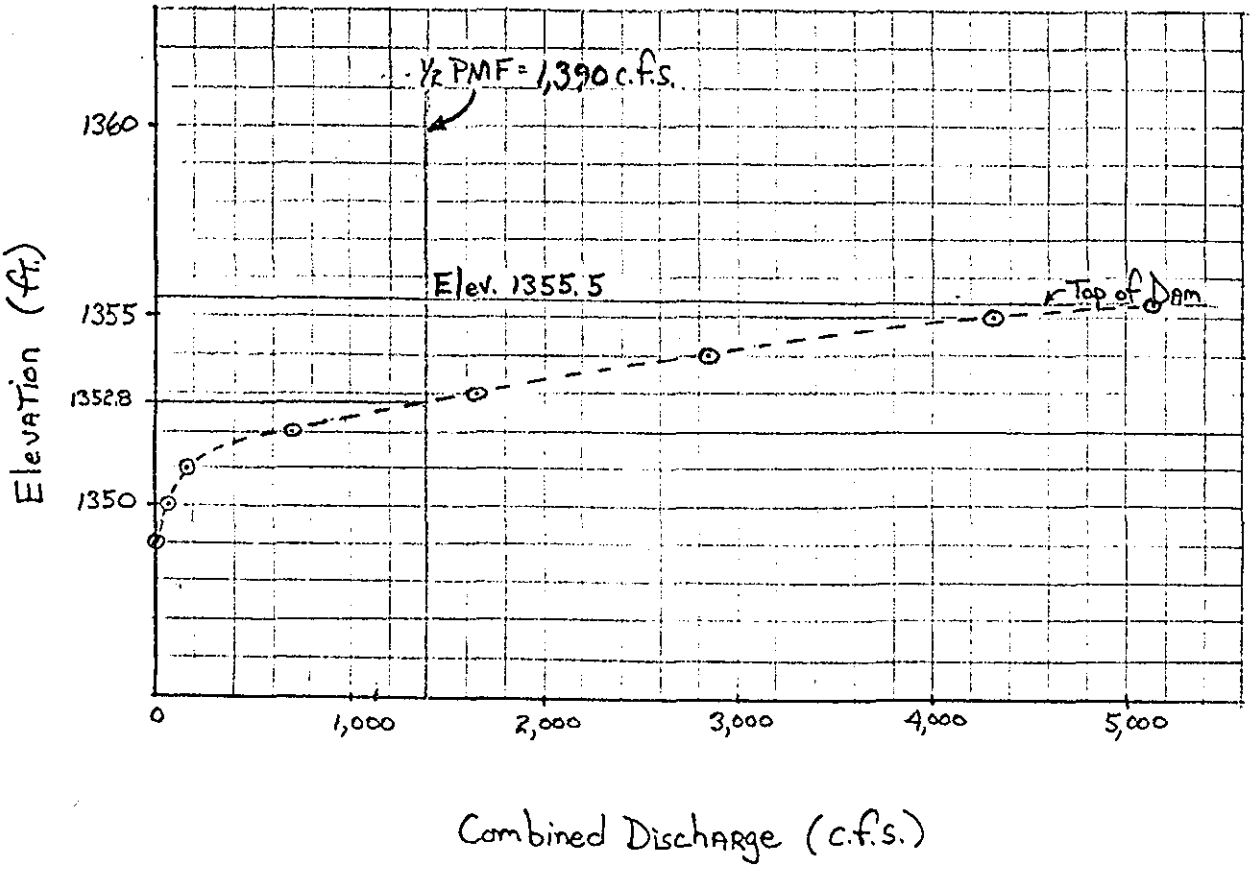
@ Northern Dam

1349	0 c.f.s	0 c.f.s.	0 c.f.s
1350	9 "	0 "	9 c.f.s.
1351	11 "	0 "	11 c.f.s
1352	11 "	78 "	89 c.f.s.
1353	11 "	220 "	231 c.f.s.
1354	11 "	405 "	416 c.f.s.
1355	11 "	624 "	635 c.f.s.
1355.5	11 "	745 "	756 c.f.s.

Spillway Rating (cont.)

Combined Stage - Discharge

Elev	Combined Discharge (Twining Pond & Northerly)
1349	0 c.f.s.
1350	81 c.f.s
1351	176 c.f.s.
1352	696 c.f.s.
1353	1,646 c.f.s.
1354	2,877 c.f.s.
1355	4,336 c.f.s.
1355.5 (Top of Dam)	5,140 c.f.s.



Spillway Rating (Cont.)

Sample Calculations

Rectangular Weir $Q = 3.33\,(L - 0.2H)\,H^{1.5}$

Orifice $Q = C A \sqrt{2gH}$ $\quad C = 0.65$

1) Compute Flow thru Primary Spillways.

Twining Pond – 2 – 2'x10' rectangular openings (one each side)

Northerly – 1 – 1'x3' rectangular opening at upstream face of structure

Assume Rectangular Weirs to top of opening then compute as an orifice.

H	Twining Pond Q	× 2 openings	Total Q	Northerly Q
1	36	2	72 c.f.s.	9.3 c.f.s.
2	91	2	182	22
3	181	2	362	27
4	209	2	418	31
5	233	2	466	35
6	256	2	512	38
6.5	266	2	532	40

2) Compute Flow thru Pipes

Twining Pond – Normal Pond Elev 1349, ℄ Pipe 1334.5, 36" ϕ Pipe @ S=2.9%/100 L=136'
Northerly – Normal Pond Elev. 1349, ℄ Pipe 1346.6, 10" ϕ Pipe @ S=10%/100 L=122'

Darcy Equation: $h_L = f \frac{l}{d} \frac{V^2}{2g}$ where $f = 0.02$ (from Moody Diagram)

Head Losses: Inlet Losses $= 0.5 \frac{V^2}{2g}$ Outlet Losses $= 1.0 \frac{V^2}{2g}$

∴ @ Twining Pond: $H = 0.5 \frac{V^2}{2g} + 1.0 \frac{V^2}{2g} + 0.9 \frac{V^2}{2g} = 2.4 \frac{V^2}{2g}$ (Hvaries from 14.5' to 21')

@ Northerly: $H = 0.5 \frac{V^2}{2g} + 1.0 \frac{V^2}{2g} + 2.9 \frac{V^2}{2g} = 4.4 \frac{V^2}{2g}$ (Hvaries from 2.4' to 8.9')

3) Compute Flow thru Spillways

Assume Broad Crested Weirs for each Emergency Spillway

$Q = C L H^{3/2}$ where $C = 2.6$
$L = 170'$
$L = 30'$

Reservoir Routing

Normal Pool Elev. = 1349

Height to pass 1,390 cfs (½ PMF) = 1352.8 feet (from graph on Pp. 7)

This is 3.8 ft over Normal Pool Elevation

Surface Area at Elevation 1352.8

From graph on Pp 1 – Area is 130 Acres

Surface Area at Elevation 1349 is 100 Acres

Volume of Surcharge Storage = $\left(\frac{130+100}{2}\right)(3.8)$ = 437 Acre-ft.

Drainage Area = 1.22 sq. mi. = 781 Acres

$$\text{Runoff} = \frac{\text{Storage}}{\text{Drainage Area}} = \text{Stor}_1 = \frac{437 \text{ Ac-ft}}{781 \text{ Ac}} = 0.56' = 6.7 \text{ inches}$$

$$Q_{P2} = Q_{P1}\left(1 - \frac{\text{Stor}_1}{19}\right) = 1{,}390\left(1 - \frac{6.7}{19}\right) = 900 \text{ c.f.s.}$$

Surcharge height for Q_{P2} is Elev. 1352.2 (from graph on Pp. 7)

Surface Area @ Elev. 1352.2 = 123 Acres

$$\text{Runoff} = \frac{\text{Storage}}{\text{D.A.}} = \frac{\left(\frac{100+123}{2}\right)(3.2)}{781} = 0.46 \text{ ft} = 5.5 \text{ inches}$$

$\text{Stor}_2 = 5.5$ inches

$$\text{Avg. Stor} = \frac{\text{Stor}_1 + \text{Stor}_2}{2} = \frac{6.7 + 5.5}{2} = \underline{6.1 \text{ inches}}$$

$Q_{P3} = Q_{P1}\left(1 - \frac{STOR_{AVG.}}{19}\right) = 1{,}390\left(1 - \frac{6.1}{19}\right) = 944$ c.f.s.

Surcharge height for Q_{P3} is Elev. 1352.3 (from graph on Pp. 7)

Surface Area @ Elev 1352.3 = 124 Acres

Volume of Surcharge Storage = $\frac{100+124}{2}(3.3) = 370$ Ac-ft.

Runoff = $\frac{370}{781} = 0.47$ ft = 5.7 inches

Avg. Stor. = $\frac{6.1+5.7}{2} = 5.9$ inches

$Q_{P4} = Q_{P1}\left(1 - \frac{STOR_{AVG}}{19}\right) = 1{,}390\left(1 - \frac{5.9}{19}\right) = 958$ Ac-ft

Surcharge height for Q_{P4} is Elev. 1352.3 (from graph on Pp. 7)

Surface Area @ Elev. 1352.3 = 124 Acres

Volume of Surcharge = $\frac{100+124}{2}(3.3) = 370$ Ac-ft

Runoff = $\frac{370}{781} = 0.47$ ft = 5.7 inches

Avg. Stor = $\frac{5.9+5.7}{2} = 5.8$ inches

$\therefore$ H = 3.3 ft above normal pool elevation or Elev. 1352.3

Q = 960 c.f.s.

The Spillways can handle the Test Flood of ½ PMF with a depth of approximately 1.8 ft at the control section (assuming the Test Flood was not routed) or a depth of approximately 1.3 ft at the control section (assuming the Test Flood was routed) This would be the elevation at <u>both</u> the Twining Pond spillway and the Northern Spillway because we assumed both would operate simultaneously.

Dam Failure Analysis – Twining Pond Dam

See Page D-25 For Northern Dam

$$Q_{p_1} = 8/27 \; W_b \sqrt{g} \; Y_o^{3/2}$$

where W_b = Breach Width (40% of dam length @ Mid height)

Y_o = Total height from River Bed to Pool Level @ failure

Q_{p_1} = Peak Failure Outflow

g = 32.2 ft/sec.

W_b = 160 ft × 40% = 64 ft.

Y_o = 23.8 ft (27 ft – 3.2 ft freeboard)

$$Q_{p_1} = 8/27 \times 64 \times \sqrt{32.2} \times 23.8^{3/2}$$

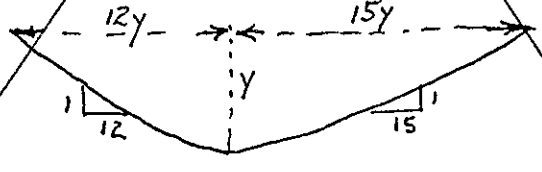
$$= 8/27 \times 64 \times 5.675 \times 23.8^{3/2}$$

Q_{p_1} = 12,500 c.f.s

Note: See page D-33 for analysis prior to dam failure

② Compute effect at First Section – Intersection of discharge stream and East Ohs Road – (48" culvert – boiler plate) Section taken just upstream of East Ohs Road.

Reach = 1500' Culvert = 48" ϕ, 30' long Freeboard = 1 ft.



Area = $\frac{15y^2}{2} + \frac{12y^2}{2} = 13.5y^2$

W.P. = 15.03y + 12.04y = 27.1y

S = 2% $R = A/W.P. = \frac{13.5y^2}{27.1y} = 0.498y$

n = 0.03

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

Assume $y = 10'$

$A = 13.5y^2 = 1,350$ s.f. W.P. $= 27.1y = 271$

$R = .498y = 4.98$

$Q = \frac{1.486}{0.03}(1,350)(4.98)^{2/3}(0.02)^{1/2}$

$Q = 27,624$ c.f.s.

Assume $y = 15$

$A = 13.5y^2 = 3,037.5$ s.f. W.P. $= 27.1y = 406.5$

$R = .498y = 7.47$

$Q = \frac{1.486}{0.03}(3,037.5)(7.47)^{2/3}(0.02)^{1/2}$

$Q = 81,670$ c.f.s.

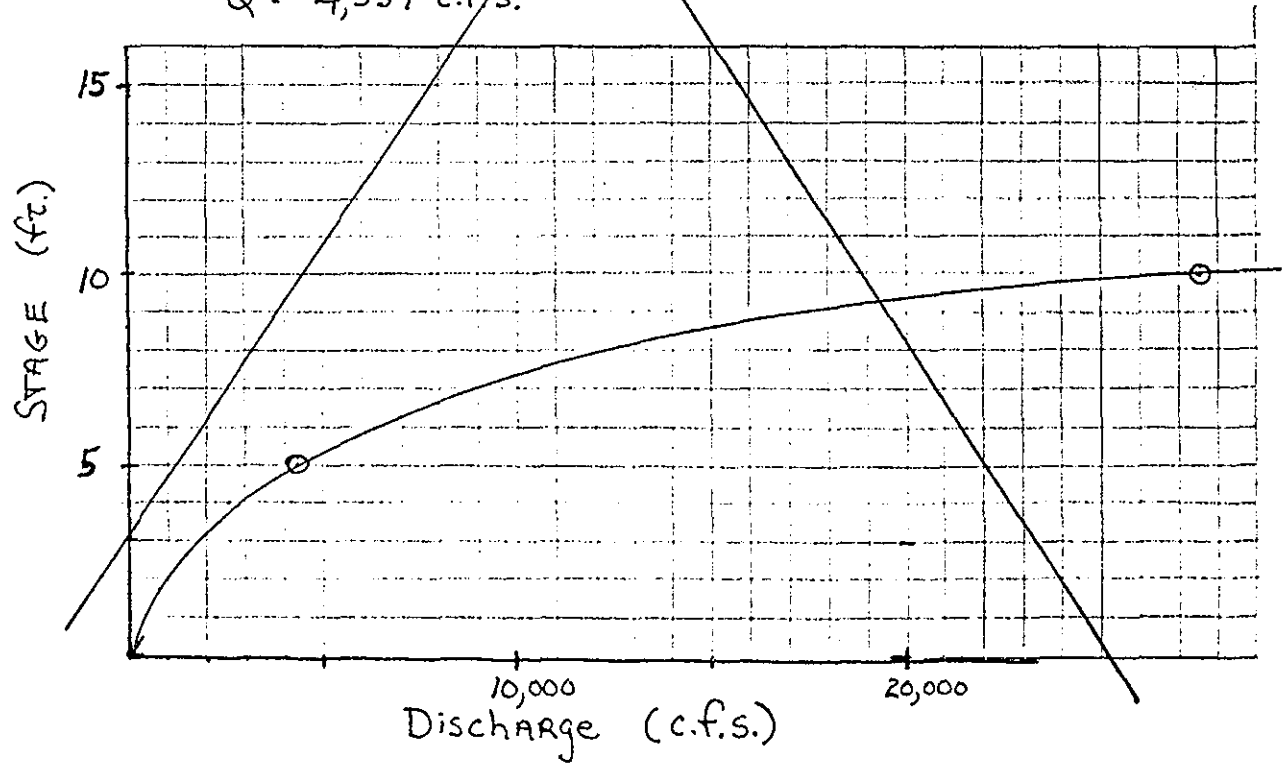
Assume $y = 5$

$A = 13.5y^2 = 337.5$ s.f. W.P. $= 27.1y = 135.5$

$R = 0.498y = 2.49$

$Q = \frac{1.486}{0.03}(337.5)(2.49)^{2/3}(0.02)^{1/2}$

$Q = 4,337$ c.f.s.



Channel Vol. = Reach × Area

for $Q_{P_1} = 12{,}500$ c.f.s.

from graph on pp. 12 $y = 8.1$ ft

$$Vol = (1500')\left(\frac{13.5(8.1)^2}{43{,}560}\right) - 1.5 = 29 \text{ ac. ft}$$

(See page D-33)

$S = 2{,}000$ Acre Feet

$$Q_{P_2}(\text{TRIAL}) = Q_{P_1}\left(1 - \frac{V_1}{S}\right)$$

$$= 12{,}500\left(1 - \frac{29}{2{,}000}\right)$$

$$Q_{P_2}(\text{TRIAL}) = 12{,}300 \text{ c.f.s.}$$

Using $Q_{P_2}(\text{TRIAL}) = 12{,}300$ c.f.s.

from graph on pp. 12 $y = 8.0$ ft.

$$V_2 = (1500')\left(\frac{13.5(8.0)^2}{43{,}560}\right) - 1.5 = 28 \text{ ac. ft.}$$

$V_2 = 28$ Ac-ft

$$V_{AVG} = \frac{V_1 + V_2}{2} = \frac{29+28}{2} = 28.5$$

$$\therefore \quad Q_{P_2} = Q_{P_1}\left(1 - \frac{V_{AVG.}}{S}\right)$$

$$= 12{,}500\left(1 - \frac{28.5}{2{,}000}\right) = 12{,}300 \text{ cfs}$$

$Q_{P_2} = 12{,}300$ c.f.s.

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Flow thru Culvert

Inlet loss = $0.9\ V^2/2g$

Outlet loss = $1.0\ V^2/2g$

Pipe loss = $0.2\ V^2/2g$ $\left(h_L = f\frac{L}{d}\frac{V^2}{2g}\right)$ where $f = 0.02$, $L = 30'$ & $d = 4'$

$H = 2.1\ V^2/2g$

For $H = 4'$, $V = 11.1$ fps $Q = 140$ c.f.s. (Assume no surcharge)

Flow over East Otis Road

$Q = 12,300 - 140 = 12,160$ cfs

Broad crested weir flow over road:

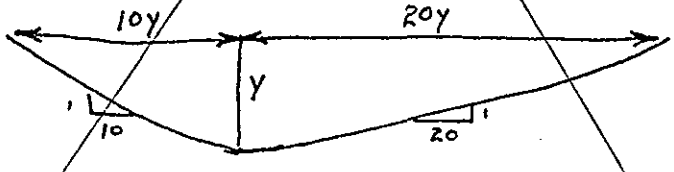
$$H = \left(\frac{Q}{3.0L}\right)^{2/3}$$

$$H = \left(\frac{12,160}{229.5(3)}\right)^{2/3} = 6.8\ ft.$$ Depth over Road $= \frac{2}{3}(6.8) = 4.6$ ft

∴ The road will be overtopped by approximately 4.6 ft.

3) Compute effect at Route 57, the section is taken just upstream of Route 57.

Reach = 2200' Culvert = 5.3 ft diameter



Area $= \frac{10y^2}{2} + \frac{20y^2}{2} = 15y^2$

W.P. $= 10.04y + 20.02y = 30.1y$

$S = 2\%$

$R = A/W.P. = \frac{15y^2}{30.1y} = 0.498y$

$n = 0.03$

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

Assume $y = 5'$

$A = 15y^2 = 375$ s.f. W.P. $= 30.1y = 150.5$ ft

$R = 0.498y = 2.49$

$Q = \frac{1.486}{0.03} \times 375 (2.49)^{2/3} (0.02)^{1/2}$

$Q = 4{,}840$ c.f.s.

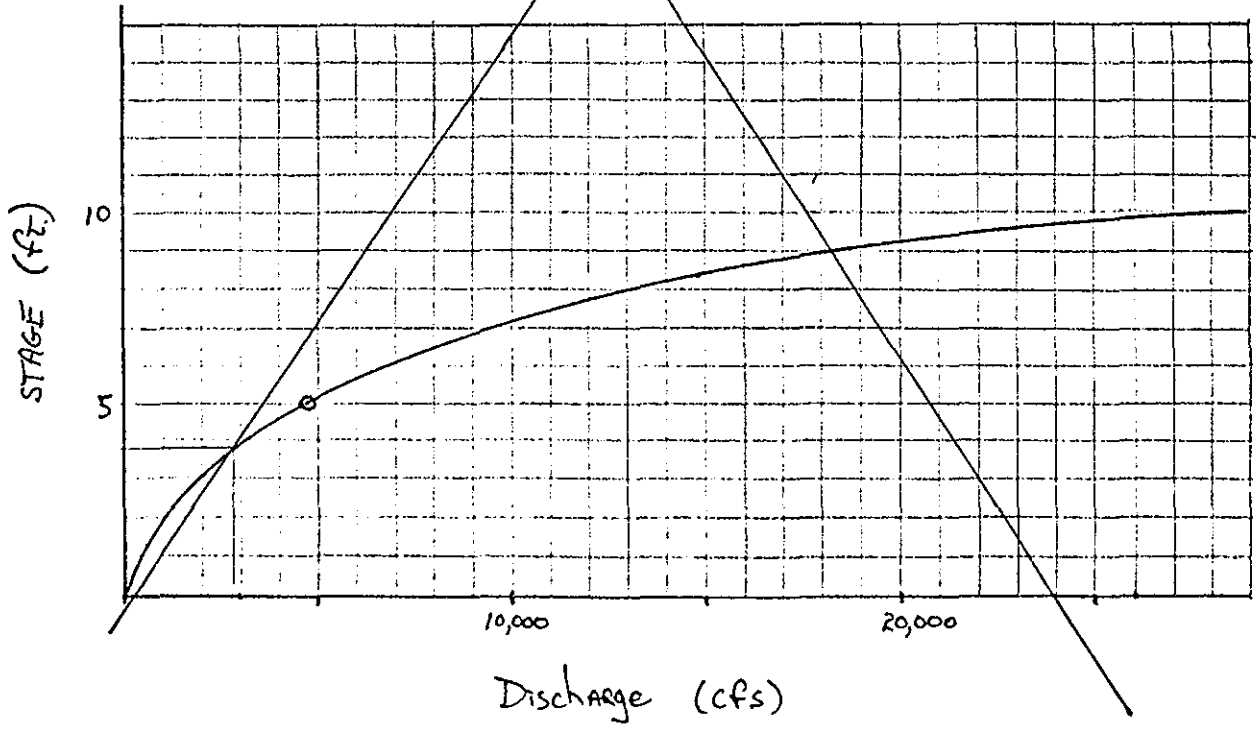
Assume $y = 10'$

$A = 15y^2 = 1500$ s.f. W.P. $= 30.1y = 301$ ft

$R = 0.498y = 4.98$

$Q = \frac{1.486}{0.03} \times 1500 (4.98)^{2/3} (0.02)^{1/2}$

$Q = 30{,}806$ c.f.s.



Channel Vol = Reach x Area

for Q_{p_1} = 12,300 c.f.s.

from graph on pp. 15 y = 7.8 ft.

$$Vol = (2{,}200)\left(\frac{15(7.8)^2}{43{,}560}\right) - 1.3 = 45 \text{ ac. ft}$$

(See page D-34)

S = 2,000 Acre-Feet

$$Q_{p_2}(\text{TRIAL}) = Q_{p_1}\left(1 - \frac{V_1}{S}\right)$$

$$= 12{,}300\left(1 - \frac{45}{2{,}000}\right) = 12{,}000 \text{ cfs}$$

$Q_{p_2}(\text{TRIAL})$ = 12,000 cfs

Using $Q_{p_2}(\text{TRIAL})$ = 12,000 cfs

from graph on pp 15 y = 7.7 ft.

$$Vol = (2{,}200)\left(\frac{15(7.8)^2}{43500}\right) - 1.3 = 44 \text{ ac. ft}$$

$$V_{ave.} = \frac{45+44}{2} = 44.5 \text{ ac. ft}$$

$$Q_{p_2} = 12{,}300\left(1 - \frac{44.5}{2000}\right) = 12{,}000 \text{ ac ft.}$$

Flow thru culvert

Inlet loss = $0.9\ V^2/2g$

Outlet loss = $1.0\ V^2/2g$

Pipe loss = $0.2\ V^2/2g$ ($h_L = f\frac{L}{d}\frac{V^2}{2g}$ where f = 0.02, L = 40' & d = 5.3')

$H = 2.1\ V^2/2g$

for h = 5.3' V = 12.7 fps Q = 280 cfs (Assume no surcharge)

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Flow over State Route 57

$Q = 12,000 - 280 = 11,720$ cfs

Broad crested weir flow over road:

$$H = \left(\frac{11,720}{249\,(3)}\right)^{2/3}$$

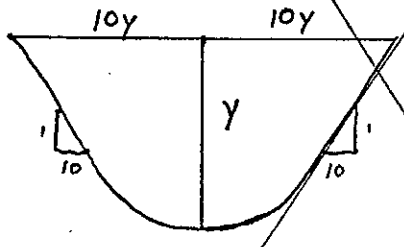
$H = 6.3$ ft Depth over Road $\approx \frac{2}{3}(6.3) = 4.2$ ft.

∴ The Road will be overtopped by approximately 4.2 ft.

4) Compute Effect at Route 8, The section is taken 900'± upstream of Route 8

Reach = 2700'

Open Channel @ end of steep slope



Area $= 10y^2$

W.P. $= 10.04y + 10.04y = 20.1y$

S = 15%

$R = A/W.P. = 10y^2/20.1y = 0.498y$

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

Assume $y = 5'$

$A = 10y^2 = 250$ s.f. W.P. $= 20.1y = 100.5$ ft

$R = 0.498y = 2.49$

$$Q = \frac{1.486}{0.03}(250)(2.49)^{2/3}(0.15)^{1/2}$$

$Q = 8,838$ c.f.s.

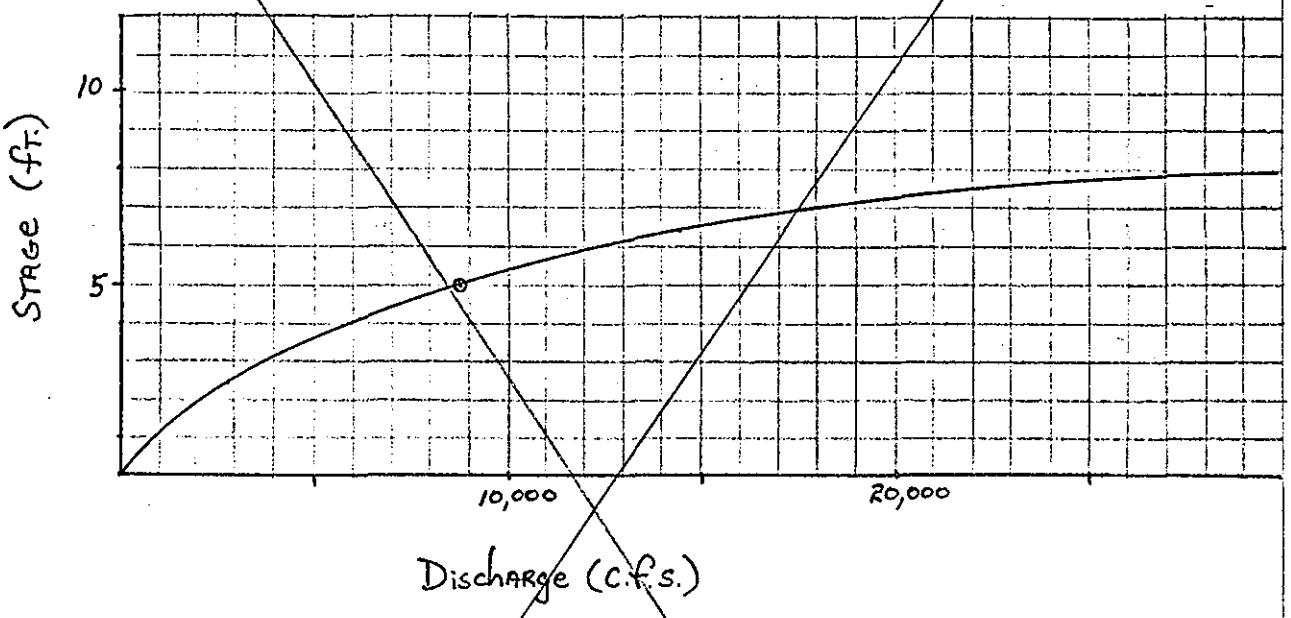
Assume $y = 8'$

$A = 10y^2 = 640$ s.f. W.P. $= 20.1y = 160.8$ ft

$R = 0.498\,y = 3.98$

$$Q = \frac{1.486}{0.03}(640)(3.98)^{2/3}(0.15)^{1/2}$$

$Q = 30,977$ c.f.s.



Channel Vol = Reach x Area

for $Q_{p_1} = 12,000$ cfs from above graph $y = 5.9$ ft

$$\text{Vol} = (2700)\left(\frac{10(5.9)^2}{43,560}\right) - 0.6 = 21 \text{ ac. ft}$$

A — (See page D-35)

S = 2,000 Acre-feet

$$Q_{p_2}(\text{TRIAL}) = Q_{p_1}\left(1 - \frac{V_1}{S}\right)$$

$$= 12,000\left(1 - \frac{21}{2000}\right)$$

$Q_{p_2}(\text{TRIAL}) = 11,900$ c.f.s.

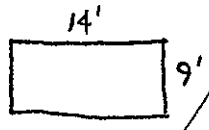
from above graph $y = 5.9$ ft

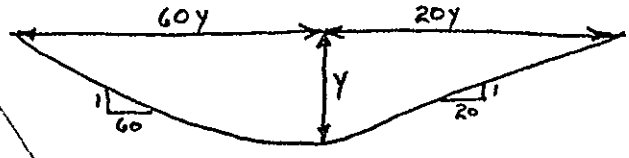
$\therefore Q_{p_2} = Q_{p_2}(\text{TRIAL}) = 11,900$ cfs.

5) Section taken just upstream of Route 8

Reach = 900'

Bridge: 60' long





$A_{REM} = \frac{60y^2}{2} + \frac{20y^2}{2} = 40y^2$

$W.P. = 60.01y + 20.02y \approx 80.1y$

$S = 7\%$

$R = A/W.P. = 40y^2/80.1y = 0.499y$

$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$ $\quad n = 0.03$

Assume $y = 2$

$A = 40y^2 = 160$ s.f.

$R = 0.499y = 0.998$

$Q = \frac{1.486}{0.03}(160)(0.998)^{2/3}(0.07)^{1/2}$

$Q = 2094$ c.f.s.

Assume $y = 5$

$A = 40y^2 = 1000$ s.f.

$R = 0.499y = 2.495$

$Q = \frac{1.486}{0.03}(1000)(2.495)^{2/3}(0.07)$

$Q = 24{,}182$ cfs.

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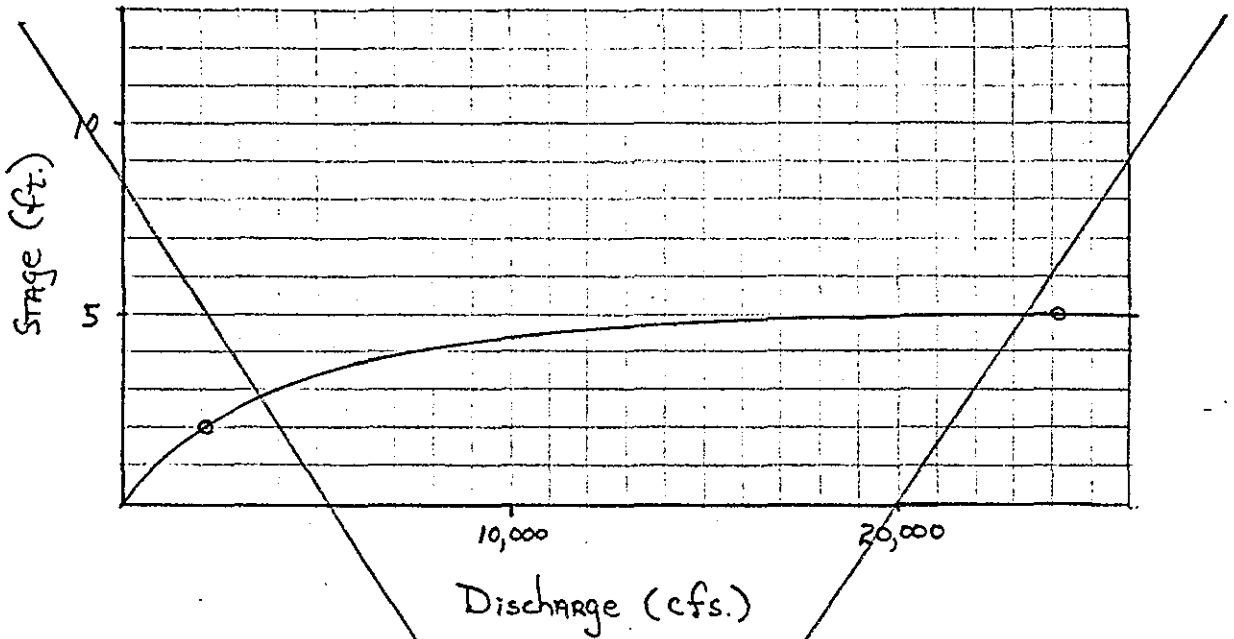


Channel Vol = Reach x Area

for Q_{p_1} = 11,900 cfs from above graph y = 4.6 ft

$$Vol = (900')\left(\frac{40(4.6)^2}{43,560}\right) - 0.8 = 17 \text{ ac. ft.}$$

(SEE PAGE D-35)

S = 2,000 Acre-Feet

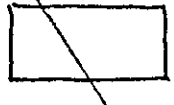
$$Q_{p_2\,(TRIAL)} = Q_{p_1}\left(1 - \frac{V_1}{S}\right)$$

$$= 11,900\left(1 - \frac{17}{2000}\right) = 11,800 \text{ cfs.}$$

$Q_{p_{2\,(TRIAL)}}$ = 11,800 c.f.s y = 4.6 ft

$\therefore\ Q_{p_2} = Q_{p_2\,(TRIAL)} = 11,800$ c.f.s.

Flow thru box culvert @ Route 8



L = 60'

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

$$Q = \frac{1.486}{0.03}(126)(3.9)^{2/3}(0.07)^{1/2}$$

Q = 4,110 cfs (ASSUMING NO SURCHARGE)

Box culvert can't handle the flow from the failure of Twining Pond Dam, therefore Route 8 will be overtopped.

Flow over Route 8.

$Q = 11,800 - 4110 = 7690$ cfs.

Broad crested weir flow over road:

$$H = \left(\frac{7690}{(352)(3)}\right)^{2/3} = 3.8 \text{ ft.}$$

Depth over Road $= \frac{2}{3}(3.8) = 2.5$ ft.

∴ Route 8 will be overtopped by approximately 2.5 ft.

6) Effect at confluence of the West Branch of the Farmington River

The West Branch of the Farmington River downstream of the confluence with the Twining Pond Dam failure flow is a broad floodplain area which will quickly attenuate the dam failure flow. In addition the Colebrook Reservoir flood protection dam is about 28,000 ± ft downstream. No additional structures or roadway crossings are threatened by a dam failure.

Dam Failure Analysis - Northern Dam

$$Q_{P_1} = 8/27\ W_b \sqrt{g}\ Y_o^{3/2}$$

where, W_b = Breach Width (40% of dam length @ Mid height)

Y_o = Total height from River Bed to Pool Level @ Failure

Q_{P_1} = Peak Failure Outflow

g = 32.2 ft./sec.

$W_b = 115\text{ ft} \times 40\% = 46\text{ ft}$

$Y_o = 19.8\text{ ft}$ (23' - 3.2' freeboard)

$$Q_{P_1} = \frac{8}{27} \times 46 \times (32.2)^{1/2} \times (19.8)^{3/2}$$

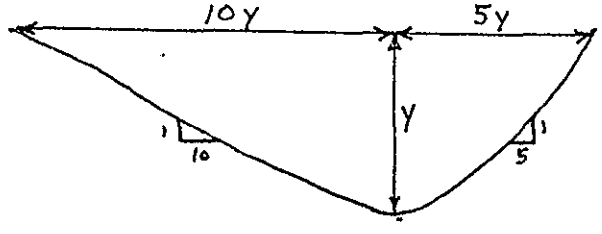
$$= \frac{8}{27} \times 46 \times 5.675 \times 88.1$$

$Q_{P_1} = 6{,}800$ cfs

Note: See page D-36 for analysis prior to dam failure

2) Compute effect at First Section - Intersection of discharge stream and East Otis Road - 30" culvert - boiler plate

Reach = 300 ft Culvert = 30" ϕ, 30ft. long Freeboard ≈ 1 ft.



$$\text{Area} = \frac{5y^2}{2} + \frac{10y^2}{2} = 7.5y^2$$

$W.P. \approx 15.1y$

$S = 2\%$ $\quad R = A/W.P. = \frac{7.5y^2}{15.1y} = 0.497y$

$n = 0.03$

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

Assume $y = 5'$

$$A = 7.5y^2 = 7.5(5)^2 = 187.5 \text{ s.f.}$$

$$R = 0.497y = 0.497(5) = 2.485$$

$$Q = \frac{1.486}{0.03}(187.5)(2.485)^{2/3}(0.02)^{1/2}$$

$$Q = 2{,}417 \text{ cfs}$$

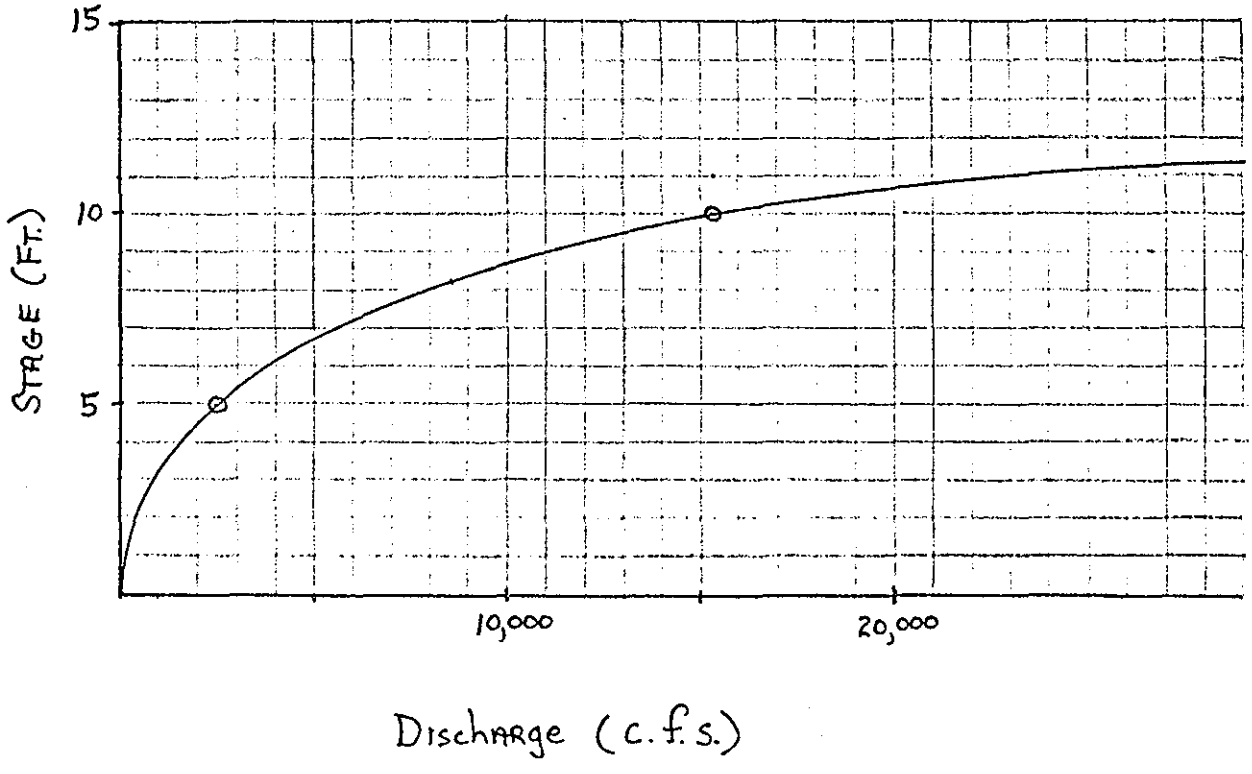
Assume $y = 10'$

$$A = 7.5y^2 = 7.5(10)^2 = 750 \text{ s.f.}$$

$$R = 0.497y = 0.497(10) = 4.97$$

$$Q = \frac{1.486}{0.03}(750)(4.97)^{2/3}(0.02)^{1/2}$$

$$Q = 15{,}383 \text{ c.f.s.}$$



Channel Vol. = Reach x Area

for Q_{p_1} = 6,800 c.f.s.

from graph on pp.23 y = 7.6 ft.

$Vol = (300)\left(\frac{7.5(7.6)^2}{43,560}\right) = 3$ Acre-ft. (prefailure storage negligible)

S = 2,000 Acre-feet

Q_{p_2} (TRIAL) = $6,800\left(1 - \frac{3}{2,000}\right)$

Q_{p_2} (TRIAL) = 6790 c.f.s.

Using Q_{p_2} (TRIAL) = 6790 c.f.s.

from graph on pp 23 y = 7.6 ft

Since height remains the same, V_{AVG} = 3 Acre-ft.

and Q_{p_2} = 6790 c.f.s.

Flow thru Culvert

Inlet loss = $0.9\ v^2/2g$

Outlet loss = $1.0\ v^2/2g$

Pipe loss = $0.2\ v^2/2g$ ($h_L = f\frac{L}{d}\frac{V^2}{2g}$) where f = 0.02, L = 30' & d = 2.5'

$H = 2.1\ v^2/2g$

For H = 2.5', V = 8.8 fps Q = 43 c.f.s. (Assume no surcharge)

Flow over East Otis Road

Q = 6790 - 43 = 6747 cfs

Broad crested weir flow over road:

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$$H = \left(\frac{Q}{3.0\,L}\right)^{2/3}$$

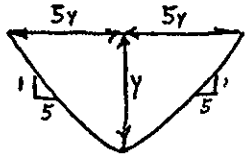
$$H = \left(\frac{6747}{(3.0)(123)}\right)^{2/3}$$

$H = 7.0$ ft. Depth over road $\approx \frac{2}{3}(7.0) = 4.7$ ft.

∴ The road will be overtopped by approximately 4.7 ft.

3) Compute effect at a point 5,000 ft downstream.

Reach = 4,700 ft



$$\text{Area} = \frac{5y^2}{2} + \frac{5y^2}{2} = 5y^2$$

$$\text{W.P.} = 10.1y$$

$S = 8\%$

$$R = A/\text{W.P.} = 5y^2/10.1y = 0.495y$$

$n = 0.03$

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

Assume $y = 5'$

$A = 5y^2 = 125$ s.f.

$R = 0.495y = 2.475$

$$Q = \frac{1.486}{0.03} \times 125\,(2.475)^{2/3}\,(0.08)^{1/2}$$

$Q = 3{,}214$ c.f.s.

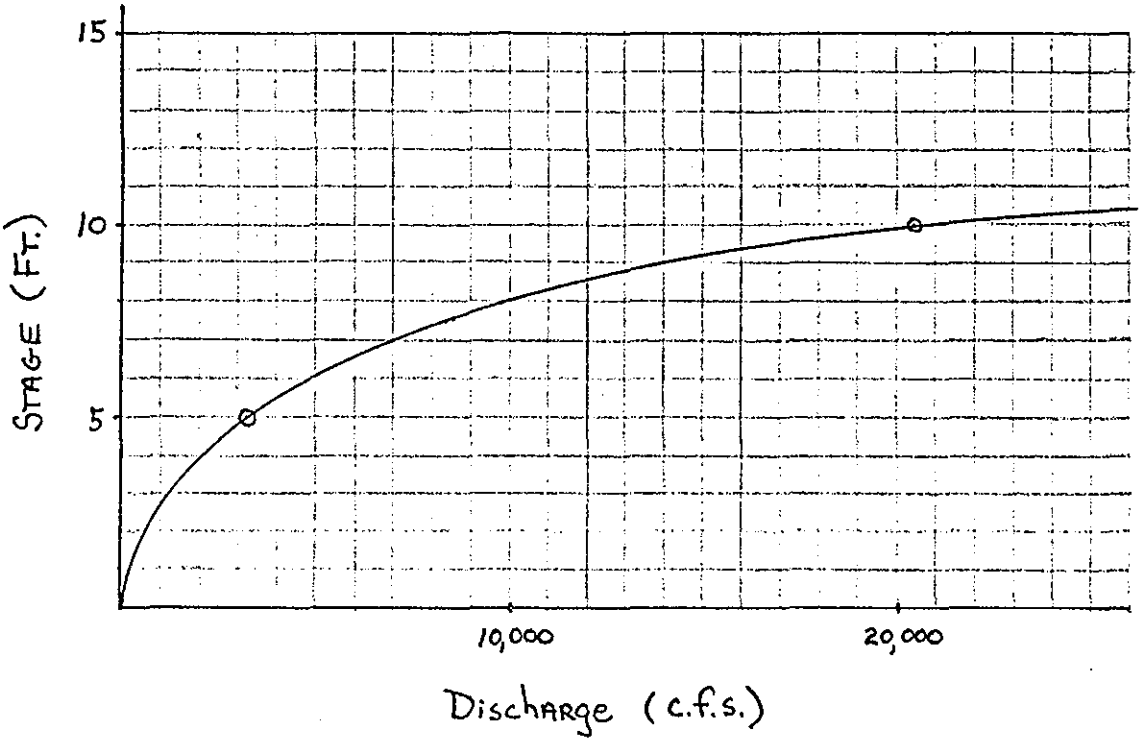
Assume $y = 10'$

$A = 5y^2 = 500$ s.f.

$R = 0.495y = 4.95$

$Q = \frac{1.486}{0.03} \times 500\,(4.95)^{2/3}(0.08)^{1/2}$

$Q = 20{,}455$ c.f.s.



Channel Vol = Reach × Area

for $Q_{P_1} = 6790$ c.f.s.

from above graph, $y = 6.9$ ft

$\text{Vol} = (4{,}700)\left(\frac{5(6.9)^2}{43{,}560}\right) - 0.5 = 25$ ac. ft.

(See page D-36)

$S = 2{,}000$ Acre-ft.

$$Q_{P_2}\ (\text{TRIAL}) = Q_{P_1}\left(1 - \frac{V_1}{S}\right)$$

$$= 6790\left(1 - \frac{25}{2{,}000}\right)$$

$$Q_{P_2}\ (\text{TRIAL}) = 6700 \text{ c.f.s.}$$

Using Q_{P_2} (TRIAL) = 6700 c.f.s

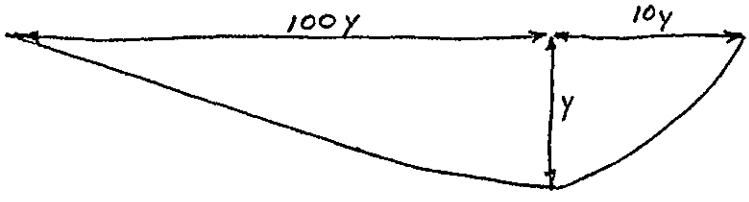
from graph on pp. 26 $y = 7.5$ ft

Since height remains the same, $V_{AVG} = 25$ Acre-ft.

and $Q_{P_2} = 6700$ c.f.s.

4) Compute effect at Confluence of the West Branch of the Farmington River

Reach = 1,800 ft.



$$\text{AREA} = \frac{100y^2}{2} + \frac{10y^2}{2} = 55y^2$$

$$\text{W.P.} \approx 110.1y$$

$S = 3\%$

$$R = A/\text{W.P.} = 55y^2/110.1y = 0.5y$$

$n = 0.03$

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

Assume $y = 5'$ $\quad A = 55y^2 = 1{,}375$ sf. $\quad R = 0.5y = 2.5$

$$Q = \frac{1.486}{0.03} \times 1{,}375\,(2.5)^{2/3}(0.03)^{1/2}$$

$$Q = 21{,}796 \text{ c.f.s.}$$

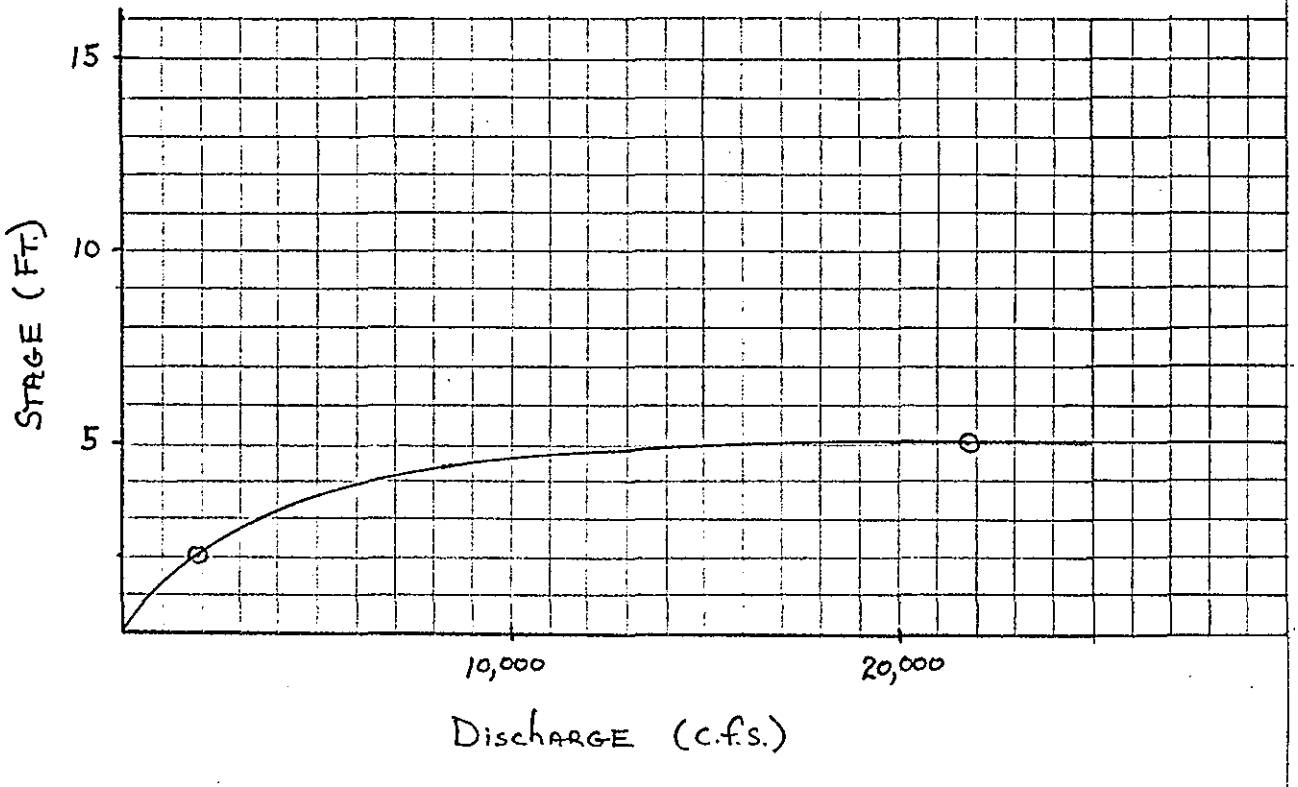
Assume $y = 2'$

$A = 55y^2 = 220$ s.f.

$R = 0.5y = 1$

$Q = \frac{1.486}{0.03} \times 220\,(1)^{2/3}\,(0.03)^{1/2}$

$Q = 1,887$ c.f.s.



Channel Vol. = Reach x Area

for $Q_{p_1} = 6,700$ c.f.s. from above graph $y = 4.1$ ft.

$\text{Vol.} = (1,800)\left(\frac{55\,(4.1)^2}{43,560}\right) = 38$ Acre-feet

$S = 2,000$ Acre-feet (prefailure storage is negligible)

$Q_{p_2}\,(\text{TRIAL}) = Q_{p_1}\left(1 - \frac{V_1}{S}\right)$

$= 6700\left(1 - \frac{38}{2,000}\right)$

$Q_{p_2}\,(\text{TRIAL}) = 6570$ c.f.s.

Using Q_{p2} (Trial) = 6570 cfs

from graph on page 28, Y = 4.1 ft.

Since height remains the same, V_{ALE} = 38 Ac. ft.

and Q_{p2} = 6570 c.f.s.

Downstream of the confluence with the West Branch of the Farmington River the dam failure flood will be quickly attenuated. No structures, road crossings or other development is threatened by a dam failure.

Analysis of Flow Prior to Dam Failure - Twining Pond Dam

See page D-36 For Northern Dam.

Routed flow from Twining Pond Dam ≈ 800 c.f.s.

Routed flow from Northern Dam ≈ 160 c.f.s.

960 c.f.s. total routed flow

2) Compute effect at the intersection of discharge stream and East Otis Road

Flow prior to dam failure = 800 c.f.s.

From graph on page 12, stage = 1.8 feet

Flow over East Otis Road (see page 14)

$Q = 800 \text{ c.f.s.} - 140 \text{ c.f.s.} = 660 \text{ c.f.s.}$

from graph on page 12, @ $Q = 660$ c.f.s., $h = 1.7$ ft.

$y = 1.7$

$2?y = 45.9$

$$H = \left(\frac{Q}{3.0\,L}\right)^{2/3}$$

$$H = \left(\frac{660}{(3.0)(45.9)}\right)^{2/3} = 2.8 \text{ ft}$$

Depth over road ≈ $\frac{2}{3}(2.8) = 1.9$ ft

∴ The road will be overtopped by approximately 1.9 feet

Storage Volume = $1500 \left(\frac{13.5(1.8)^2}{43{,}560}\right) = 1.5$ ac ft.

3) Compute effect at Route 57

Flow prior to dam failure = 800 c.f.s.

From graph on page 15, stage = 1.8 feet

Flow over State Road 57 (see page 17)

$Q = 800 \text{ c.f.s.} - 280 \text{ c.f.s.} = 520 \text{ c.f.s.}$

From graph on page 15, $y = 1.3$ feet

@ $y = 1.3$ $L = 30y = 39$ ft.

$$H = \left(\frac{520}{(39)(3.0)}\right)^{2/3}$$

$H = 2.7$ ft.

Depth over road $= \frac{2}{3}(2.7) = 1.8$

∴ The road will be overtopped by approximately 1.8 feet

Storage Vol $= 2200 \dfrac{(15(1.3)^2)}{43{,}560} = 1.3$ ac. ft.

4) Compute effect approximately 900 ft. ± upstream of Route 8

Flow prior to dam failure = 800 c.f.s.

From graph on page 18, stage = 1.0 feet

$$\text{Storage Vol} = 2700 \left(\frac{10(1.0)^2}{43{,}560}\right) = 0.6 \text{ ac. ft.}$$

5. Compute effect just upstream of Route 8

Flow prior to dam failure = 800 cfs.

From graph pgs. 20 (D-23), stage = 1.0 ft

$$\text{Storage Vol} = 900 \frac{(40(1.0)^2)}{43{,}560} = 0.8 \text{ ac. ft.}$$

Analysis of Flow Prior to Dam Failure: Northern Dam

Routed flow from Northern Dam = 160 CFS

2) Compute effect at intersection of discharge stream and East Otis Road.

Flow prior to failure = 160 CFS
from graph page. 23 (D-26), stage = 1.0 ft

Flow over East Otis Road:

$Q = 160 \text{ cfs} - 43 \text{ cfs} = 117 \text{ cfs}$.

$$H = \left(\frac{Q}{(3)(L)}\right)^{2/3} = \left(\frac{117}{(3)(100)}\right)^{2/3} = 0.5 \text{ ft}$$

Depth over road = $\frac{2}{3}(0.5) = 0.3$ ft
Storage Volume is negligible

3) Compute effect at a point 5,000 ft downstream.

Flow prior to failure = 160 CFS.
from graph page. 26 (D-29), stage = 1.0 ft

$$\text{Storage Volume} = 4{,}700\left(\frac{(5)(1.0)^2}{43{,}520}\right) = 0.5 \text{ ac. ft.}$$

4) Compute effect at confluence with West Branch of the Farmington River:

Flow prior to failure = 160 CFS

from graph page 28 (D-31), stage = 0.3 ft

Storage Volume is negligible

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

(1) STATE	(2) IDENTITY NUMBER	(3) DIVISION	(4) STATE	(5) COUNTY	(6) CONGR DIST.	(7) STATE	(8) COUNTY	(9) CONGR DIST.	(9) NAME	(10) LATITUDE (NORTH)	(11) LONGITUDE (WEST)	(12) REPORT DATE DAY	MO	YR
MA	1059	NED	MA	013	01				TWINING POND (NORTH DAM)	4206.3	7303.2	30	JUN	79

(13) POPULAR NAME	(14) NAME OF IMPOUNDMENT
LOST WILDERNESS	LOST WILDERNESS LAKE

(15) REGION	(16) BASIN	(17) RIVER OR STREAM	(18) NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	(19) DIST FROM DAM (MI.)	(20) POPULATION
01	08	TR-W BRANCH FARMINGTON RIVER	SANDISFIELD (NEW BOSTON)	2	650

(21) TYPE OF DAM	(22) YEAR COMPLETED	(23) PURPOSES	(24) STRUCTURAL HEIGHT (FT.)	(25) HYDRAULIC HEIGHT (FT.)	(26) IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	NORMAL (ACRE-FT.)	(27) DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
REPG	1976	R	21	18	1100	500	NED	N	N	N	N	

(28) REMARKS

(29) D/S HAS	(30) SPILLWAY CREST LENGTH	(31) SPILLWAY TYPE	(32) SPILLWAY WIDTH (FT.)	(33) MAXIMUM DISCHARGE (FT.)	(34) VOLUME OF DAM (CY)	(35) POWER CAPACITY INSTALLED (MW)	(36) POWER CAPACITY PROPOSED (MW)	(37) NAVIGATION LOCKS NO.	(38) LENGTH (FT.)	(39) WIDTH (FT.)	(40) LENGTH (FT.)	(41) WIDTH (FT.)	(42) LENGTH (FT.)	(43) WIDTH (FT.)	(44) LENGTH (FT.)	(45) WIDTH (FT.)
2	660	U	30	650	12000											

(46) OWNER	(47) ENGINEERING BY	(48) CONSTRUCTION BY
LOST WILDERNESS INC	RG BROWN ASSOC INC	HEBERT CONST CO

(49) REGULATORY AGENCY DESIGN	(50) CONSTRUCTION	(51) OPERATION	(52) MAINTENANCE

(53) INSPECTION BY	(54) INSPECTION DATE DAY	MO	YR	(55) AUTHORITY FOR INSPECTION

(56) REMARKS

32-MT4.5 30-240 FT DAM < 440 FT DIKE